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SECTION 44 05 13 – GENERAL REQUIREMENTS FOR EQUIPMENT

SECTION 44 05 13

GENERAL REQUIREMENTS FOR EQUIPMENT

PART 1 – GENERAL

1.01 DESCRIPTION

A. Scope:

This section specifies general requirements which are applicable to all mechanical equipment. The Contractor is responsible for ensuring that all mechanical equipment meets the requirements of this section in addition to the specific requirements of each individual equipment specification section.

B. Equipment Lists:

Equipment lists, presented in these specifications and as specified on the drawings, are included for the convenience of the Construction Manager and Contractor and are not complete listings of all equipment, devices and material required to be provided under this contract. The Contractor shall prepare his own material and equipment takeoff lists as necessary to meet the requirements of this project manual.

1.02 QUALITY ASSURANCE

A. Arrangement:

The arrangement of equipment shown on the drawings is based upon information available to the Owner at the time of design and is not intended to show exact dimensions conforming to a specific manufacturer. The drawings are, in part, diagrammatic, and some features of the illustrated equipment installation may require revision to meet actual submitted equipment installation requirements; these may vary significantly from manufacturer to manufacturer. The contractor shall, in determining the cost of installation, include these differences as part of his bid proposal. Structural supports, foundations, connected piping, valves, and electrical conduit specified may have to be altered to accommodate the equipment actually provided. No additional payment shall be made for such revisions and alterations.

B. References:

This section contains references to the documents listed below. They are a part of this section as specified and modified. Where a referenced document cites other standards, such standards are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have

been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, has been discontinued or has been replaced.

Reference	Title
ABMA Std 9	Load Ratings and Fatigue Life for Ball Bearings
ABMA Std 11	Load Ratings and Fatigue Life for Roller Bearings
ANSI B1.1	Unified Inch Screw Threads (UN and UNR Thread Form)
ANSI B1.20.1	Pipe Threads, General Purpose (Inch)
ANSI B16.1	Gray Iron Pipe Flanges and Flanged Fittings, (Classes 25, 125, and 250)
ANSI B18.2.1	Square and Hex Bolts and Screws (Inch Series)
ANSI B18.2.2	Square and Hex Nuts (Inch Series)
ANSI S2.19	Mechanical Vibration – Balance Quality Requirements of Rigid Rotors, Part 1: Determination of Permissible Unbalance, Including Marine Applications

C. Unit Responsibility:

The Contractor shall cause equipment assemblies made up of two or more components to be provided as a working unit by the unit responsibility manufacturer, where specified. The unit responsibility manufacturer shall coordinate selection, coordinate design, and shall provide all mechanical equipment assembly components such that all equipment components furnished under the specification for the equipment assembly, and all equipment components specified elsewhere but referenced in the equipment assembly specification, is compatible and operates reliably and properly to achieve the specified performance requirements. Unless otherwise specified, the unit responsibility manufacturer shall be the manufacturer of the driven component equipment in the equipment assembly. The unit responsibility manufacturer is designated in the individual equipment specifications found elsewhere in this project manual. Agents, representatives or other entities that are not a direct division of the driven equipment manufacturing corporation shall not be accepted as a substitute for the driven equipment manufacturer in meeting this requirement. The requirement for unit responsibility shall in no way relieve the Contractor of his responsibility to the Owner for performance of all systems as provided in paragraph 00710–2.04.

The Contractor shall ensure that all equipment assemblies provided for the project are products for which unit responsibility has been accepted by the unit responsibility manufacturer(s), where specified. Unit responsibility for related components in a mechanical equipment assembly does not require or obligate the unit responsibility manufacturer to warranty the workmanship or quality of component products not manufactured by them. Where an individual

specification requires the Contractor to furnish a certificate from a unit responsibility manufacturer, such certificate shall conform to the content, form and style of Form 44 05 13–C specified in Section 01 99 90, shall be signed by an officer of the unit responsibility manufacturer's corporation and shall be notarized. No other submittal material will be processed until a Certificate of Unit Responsibility has been received and has been found to be satisfactory. Failure to provide acceptable proof that the unit responsibility requirement has been satisfied will result in withholding approval of progress payments for the subject equipment *even though the equipment may have been installed in the work.*

D. Balance:

Unless specified otherwise, for all machines 10 HP and greater, all rotating elements in motors, pumps, blowers and centrifugal compressors shall be fully assembled, including coupling hubs, before being statically and dynamically balanced. All rotating elements shall be balanced to the following criteria:

$$U_{per} = 6.015\frac{GW}{N}$$

Where:

U_{per} = permissible imbalance, ounce–inches, maximum

G = Balance quality grade, millimeters per second

W = Weight of the balanced assembly, pounds mass

N = Maximum operational speed, rpm

Where specified, balancing reports, demonstrating compliance with this requirement, shall be submitted as product data. Equipment balance quality grade shall be G 2.5 (G = 2.5 mm/sec) or better in accordance with ANSI S2.19.

PART 2 – PRODUCTS

2.01 FLANGES AND PIPE THREADS

A. Flanges on equipment and appurtenances provided under this section shall conform in dimensions and drilling to ANSI B16.1, Class 125. Pipe threads shall conform in dimension and limits of size to ANSI B1.1, coarse thread series, Class 2 fit.

Threaded flanges shall have a standard taper pipe thread conforming to ANSI B1.20.1. Unless otherwise specified, flanges shall be flat faced.

Flange assembly bolts shall be heavy pattern, hexagonal head, carbon steel machine bolts with heavy pattern, hot pressed, hexagonal nuts conforming to ANSI B18.2.1 and B18.2.2. Threads shall be Unified Screw Threads, Standard Coarse Thread Series, Class 2A and 2B, ANSI B1.1.

A. Bearings

Unless otherwise specified, equipment bearings shall be oil or grease lubricated, ball or roller type, designed to withstand the stresses of the service specified. Each bearing shall be rated in accordance with the latest revisions of ABMA Methods of Evaluating Load Ratings of Ball and Roller Bearings. Unless otherwise specified, equipment bearings shall have a minimum L–10 rating life of 50,000 hours. The rating life shall be determined using the maximum equipment operating speed.

Grease lubricated bearings, except those specified to be factory sealed and lubricated, shall be fitted with easily accessible grease supply, flush, drain and relief fittings. Extension tubes shall be used when necessary. Grease supply fittings shall be standard hydraulic alemite type.

Oil lubricated bearings shall be equipped with either a pressure lubricating system or a separate oil reservoir type system. Each oil lubrication system shall be of sufficient size to safely absorb the heat energy normally generated in the bearing under a maximum ambient temperature of 60 °C and shall be equipped with a filler pipe and an external level indicator gage.

All bearings accessible to touch, and located within seven feet measured vertically from floor or working level or within 15 inches measured horizontally from stairways, ramps, fixed ladders or other access structures, shall either incorporate bearing housings with sufficient cooling to maintain surface temperature at 65 °C or less for continuous operation at bearing rated load and a 50 °C ambient temperature or shall be provided with appropriate shielding shall be provided that will prevent inadvertent human contact.

2.02 V–BELT ASSEMBLIES

A. Unless otherwise specified, V–belt assemblies shall be Dodge Dyna–V belts with matching Dyna–V sheaves and Dodge Taper–lock bushings, Wood's Ultra V–belts with matching Ultra–V sheaves and Wood's Sure–Grip bushings, or equal.

Sheaves and bushings shall be statically balanced. Additionally, sheaves and bushings which operate at a peripheral speed of more than 5500 feet per minute shall be dynamically balanced. Sheaves shall be separately mounted on their bushings by means of three pull–up grub or cap tightening screws. Bushings shall be key seated to the drive shaft.

Belts shall be selected for not less than 150 percent of rated driver horsepower and, where two sheaves sizes are specified, shall be capable of operating with either set of sheaves. Belts shall be of the antistatic type where explosion proof equipment is specified.

2.03 PUMP SHAFT SEALS

A. General:

Seals for water and wastewater pump shafts shall be either stuffing box or mechanical seals. For industrial wastewater service, or for fluids other than water or municipal wastewater, the recommendations of the seal manufacturer shall be

followed for selection of appropriate seals. Unless specified otherwise, stuffing boxes and mechanical seals shall conform to the requirements set forth in this paragraph.

B. Mechanical Seals:

Unless otherwise specified in the detailed pump specifications, mechanical seals shall be split mechanical seals requiring no field assembly, other than assembly around the shaft and insertion into the pump. They shall be self–aligning, and self–centering, single seals. They shall be of a nondestructive (nonfretting) type requiring no wearing sleeve for the shaft. Shafts for pumps specified with mechanical seals shall be furnished with no reduction in size through the seal area (no shaft sleeve). Where the detailed specifications call for cartridge instead of split seals, all other requirements of this paragraph apply.

Metal parts shall be Type 316 or 316L stainless steel. Springs shall be Hastelloy C, Elgiloy, or other Duplex SS selected for resistance to chloride attack. Rotary faces shall be silicon carbide or chrome oxide. Stationary faces shall be silicon carbide for solids bearing fluid service and carbon for clean water service. Elastomers shall be ethylene propylene or fluorocarbon. Mechanical seals shall be suitable for operation between full vacuum (0 psia) up to 200 percent of the maximum specified operating pressure, but in any event not less than 200 psig.

Seal chambers shall be provided with vented solids removal restriction bushings except for enclosed line shaft pumps where the seal barrier fluid is used for line shaft bearing lubrication. The bushing shall both control the amount of flushing water flow and restrict solids and gas accumulation from the seal face area.

Candidate seals include:

1. Chesterton 442 seals provided with Chesterton/SpiralTrac solids removal restriction bushings Version N or D, as recommended by EnviroSeal Engineering Products, Ltd, Nova Scotia, Canada.

2. AESSEAL RDS seals with Cyclops bushing.

3. John Crane 3710 seals with Type 24SL bushing.

Seals on pumps for contaminated water service (sludge, grit, wastewater, scum, reclaimed water, etc.) shall be drilled and tapped for connection of a clean water flushing supply.

Seals for all vertical pumps (whether column or volute type) shall be provided with a second flush connection. Vertical pumps shall have a vent valve attached to the mechanical seal to eliminate air from the seal chamber prior to pump start; start–up procedures shall include venting instructions; and for remotely started pumps, the vent system shall be automated. Where specified in the detailed specifications, permissive confirmation automatic vent systems shall be provided.

C. Shaft Packing:

Where shaft packing is specified, stuffing boxes shall be tapped to permit introduction of seal liquid and shall hold a minimum of five rows of packing. Stuffing boxes shall be face attached. Stuffing box and shaft shall be suitable for field installation, without machining or other modifications, of the mechanical seal specified in paragraph 44 05 13–2.04.B for the applicable pump and operating conditions.

Unless otherwise specified, lantern rings shall be bronze or Teflon, packing shall be die–molded packing rings of non–asbestos material suitable for the intended service and as recommended by the manufacturer, and glands shall be bronze, two piece split construction. Lantern rings shall be of two–piece construction and shall be provided with tapped holes to facilitate removal. Lantern rings shall be drilled and tapped 1/4 NC–20. The impeller end of the packing on all but line shaft pumps with external source water lubricated bearings shall be fitted with a SpiralTrac, Version P packing protection system as manufactured by EnviroSeal Engineering Products, Ltd, Nova Scotia, Canada.

The section of each shaft or impeller hub that extends through or into the stuffing box shall be fitted with a replaceable stainless-steel sleeve with a Brinell hardness of not less than 500. The sleeve shall be held to the shaft to prevent rotation and shall be gasketed to prevent leakage between the shaft and the sleeve. Minimum shaft sleeve thickness shall be 3/8 inch.

2.04 COUPLINGS

A. Unless otherwise specified in the particular equipment sections, equipment with a driver greater than 1/2 HP, and where the input shaft of a driven unit is directly connected to the output shaft of the driver, shall have its two shafts connected by a flexible coupling which can accommodate angular misalignment, parallel misalignment and end float, and which cushions shock loads and dampens torsional vibrations. The flexible member shall consist of a tire with synthetic tension members bonded together in rubber. The flexible member shall be attached to flanges by means of clamping rings and cap screws, and the flanges shall be attached to the stub shaft by means of taper lock bushings which shall give the equivalent of a shrunk–on fit. There shall be no metal–to–metal contact between the driver and the driven unit. Each coupling shall be sized and provided as recommended by the coupling manufacturer for the specific application, considering horsepower, speed of rotation, and type of service.

Where torque or horsepower capacities of couplings of the foregoing type is exceeded, Thomas–Rex, Falk Steel Flex, or equal, couplings will be acceptable provided they are sized in accordance with the equipment manufacturer's recommendations and sizing data are submitted. They shall be installed in conformance to the coupling manufacturer's instructions.

2.05 GUARDS

A. Exposed moving parts shall be provided with guards which meet all applicable OSHA requirements. Guards shall be fabricated of 14–gage steel, 1/2–13–15 expanded metal screen to provide visual inspection of moving parts without

removal of the guard. Guards shall be galvanized after fabrication and shall be designed to be readily removable to facilitate maintenance of moving parts. Reinforced holes shall be provided. Lube fittings shall be extended through guards.

2.06 CAUTION SIGNS

A. Equipment with guarded moving parts which operates automatically or by remote control shall be identified by signs reading "CAUTION – AUTOMATIC EQUIPMENT MAY START AT ANY TIME". Signs shall be constructed of fiberglass material; minimum 1/8-inch-thick, rigid, suitable for post mounting. Letters shall be white on a red background. The sign size and pattern shall be as shown on the drawings. Signs shall be installed near guarded moving parts.

2.07 GAGE TAPS, TEST PLUGS, AND GAGES

A. Gage taps shall be provided on the suction and discharge sides of pumps, blowers and compressors. Pressure and vacuum gages shall be provided where specified. Gage taps, test plugs, and gages shall be as specified in Division 40.

2.08 NAMEPLATES

A. Nameplates shall be provided on each item of equipment and shall contain the specified equipment name or abbreviation and equipment number. Equipment nameplates shall be engraved or stamped stainless steel and fastened to the equipment in an accessible and visible location with stainless steel screws or drive pins.

2.09 LUBRICANTS

A. The Contractor shall provide for each item of mechanical equipment a supply of the required lubricant adequate to last through the specified commissioning period. Lubricants shall be of the type recommended by the equipment manufacturer and shall be products of the Owner's current lubricant supplier. The Contractor shall limit the various types of lubricants by consolidating them, with the equipment manufacturer's approval, into the least number of different types. Not less than 90 days before the date shown in his construction schedule for starting, testing and adjusting equipment, the Contractor shall provide the Owner with three copies of a list showing the required lubricants, after consolidation, for each item of mechanical equipment. The list shall show estimated quantity of lubricant needed for a full year's operation, assuming the equipment will be operating continuously.

2.10 ANCHOR BOLTS

A. Anchor bolts shall be designed for lateral forces for both pullout and shear per the structural specifications.

2.11 SPARE PARTS

A. Spare parts, wherever required by detailed specification sections, shall be stored in accordance with the provisions of this paragraph. Spare parts shall be tagged by

project equipment number and identified by part number, equipment manufacturer, and subassembly component (if appropriate). Spare parts subject to deterioration, such as ferrous metal items and electrical components, shall be properly protected by lubricants or desiccants and encapsulated in hermetically sealed plastic wrapping. Spare parts with individual weights less than 50 pounds and dimensions less than 2 feet wide, or 18 inches high, or 3 feet in length shall be stored in a wooden box with a hinged wooden cover and locking hasp. Hinges shall be strap type. The box shall be painted and identified with stenciled lettering stating the name of the equipment, equipment numbers, and the words "spare parts." A neatly typed inventory of spare parts shall be taped to the underside of the cover.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Installation of equipment accessories included in this section shall be as recommended by the equipment manufacturer unless otherwise specified in the individual equipment specification section.

END OF SECTION

SECTION 44 11 20.18

ODOR CONTROL
EXTRUDED ALUMINIUM FLAT COVER

PART 1 – GENERAL

1.01 DESCRIPTION

A. This section defines the design requirements for the aluminum extruded flat cover(s) as described in the contract drawings and documents.

1.02 SUBMITTALS

A. Before executing any of the work in this section, prints or drawings shall be submitted to the engineer showing dimensions, sizes, thickness, gauges, materials, finishes, joint attachment and erection procedure. Drawings shall bear the seal and signature of the design engineer, registered in the state of the project.

B. A complete set of design calculations for the cover(s) shall also be submitted. These calculations shall be signed by a registered professional engineer registered in the state of the project. Provide shop drawings to Engineer for approval. All work shall be fabricated and erected in accordance with the approved drawings.

C. Certification that the specified material alloys, sizes and quantities have been furnished shall be submitted upon completion of the project.

1.03 REFERENCES

A. The following codes and standards form a part of this section to the extent specified herein:

1. ASTM C–864–90 Standard Specifications for Preformed Gasket and Sealing Material

2. Aluminum Association Specifications for Aluminum Structures

3. Aluminum Association Aluminum Design Manual; Specifications and Guidelines for Aluminum Structures

4. ASCE 8–02 Specification for the Design of Cold–Formed Stainless Steel Structural Members

5. ASTM F593 Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs

6. Federal Specification TT – S – 00230C

PART 2 – PRODUCTS

2.01 DESCRIPTION

A. The extruded flat covers shall be clear–span and self–supporting from the peripheral structure. The cover system shall consist of removable panels each weighing no more than 150 pounds. The required lifting force per panel shall not exceed the dead weight of the panel. The extruded panels utilize specially extruded panel structural members, slip–resistant top planks with stiffeners, and integral perimeter flashing/endcaps. Both male and female panels must independently be designed to meet both the design loading and the deflection limits specified herein. Elastomeric weatherseal gasket shall form a continuous substantially watertight seal along all panel edges. The gaskets shall be fully enclosed to prevent ultraviolet exposure.

B. Each panel must be able to be removed without needing to remove more than the two adjacent panels. The need for removing separate flashing or "hold–down" extrusions longer than the width of the panel is prohibited. Primary panel support members shall be integral to the panels. Upon removal of the panels, the entire area beneath the panels shall be exposed and no substructure in the form of beams or box–beams shall remain in the basin(s) to be covered. To facilitate removal, panels shall incorporate integral lifting handles. Handles shall be located at both ends of the cover panels and shall not penetrate the cover panels or pond water.

C. The extruded flat cover shall have an integral bi–directional slip resistant surface which extends a minimum of 0.1–inch above the panel surface. Raised surfaces without the use of texturing to achieve slip resistance are not acceptable. The use of checkered plate, paint, tape, sandblasting, or other applied systems to achieve the slip resistant surface is expressly prohibited.

D. The extruded flat cover system shall be Flush Mount, with the covers slip resistant walking surface flush with the top of the basin or tank wall. Lifting handles shall be integral with the panel endcaps.

E. All metal components of the flat cover structure shall be aluminum or 300 series stainless steel. No galvanized, painted, or plated steel shall be used. The use of structural plastic is expressly prohibited. Dissimilar materials in the supporting structure shall be isolated from the aluminum flat cover by means of a compatible elastomeric gasket.

F. The use of structural members in contact with the contents of the tank is expressly prohibited.

G. The design shall prevent water pooling which may result in over–stressing the flat cover.

H. The extruded flat cover will have a mill finish surface.

I. Fasteners shall be designed with a factor of safety of 2.34 on ultimate strength and 1.65 on yield strength.

J. The removable extruded flat cover system shall be designed to be substantially air and water tight under the specified design loading conditions

2.02 EXPERIENCE/QUALIFICATIONS

A. No equipment shall be supplied by any manufacturer not regularly engaged in the manufacturing and production of extruded flat cover(s) in the size and character herein specified. The manufacturer must have designed, manufactured and installed at least one (1) formed panel flat cover of the same type and size as unit(s) specified herein. This flat cover must be in satisfactory use for a period not less than ten (10) years.

B. The cover manufacturer must own and operate its own US–based manufacturing facility, and the use of a fabrication facility that is not US–based and/or owned and operated by the cover manufacturer is expressly prohibited. Manufactures that do not meet these qualifications will not be considered.

C. The cover manufacturer must be ISO 9001 certified.

2.03 MATERIALS

A. The following is a summary of approved materials and/or material specifications. All aluminum alloys shall be as defined by the Aluminum Association and published in the ALUMINUM STANDARDS AND DATA.

1. **Bolts and Fasteners** – Bolts shall be 300 series stainless steel per ASTM F593, Alloy Group 1. Lock bolts shall be 7075–T73 aluminum or 305 stainless steel. Screws shall be aluminum or 300 series stainless steel.

2. **Structural Shapes** – Aluminum structural shapes shall be alloy 6061–T6 or 6063–T6. Load supporting surfaces shall be 0.1–inch minimum thickness.

3. **Miscellaneous Shapes** – Miscellaneous aluminum shapes shall be alloy 6061–T6 or 6063–T6.

4. **Gaskets** – All gaskets shall be Neoprene conforming to ASTM C–864–90, resistant to ozone and shielded from exposure to ultraviolet light. The gaskets must have a ¼" minimum thickness.

5. **Sealant** – All sealants shall be silicone, GE Silpruf SCS 9000.09 and resistant to ozone and ultraviolet light and conform to Federal Specification TT–S–00230C.

6. **Miscellaneous Penetration Seals**– All other penetration seals shall be weatherproof rubber seals.

7. **Support Bearings** – Bearings at the supports (if required) shall conform to AASHTO Division 2 Section 25. Acceptable bearing surfaces for sliding bearings are Teflon to stainless steel only. In order to avoid damage to the

Teflon and to reduce the coefficient of bearing friction, Teflon shall not bear on aluminum surfaces.

2.04 DESIGN LOADS

A. The entire extruded flat cover structure shall be designed to sustain the loads specified herein, within the stress limitations of the Aluminum Association Aluminum Design Manual. In no case shall the formed panel flat cover be designed for any loads less than those specified by the local building code and/or local amendments.

B. The load cases to be considered shall be those described below unless more severe loads are specified by the purchaser.

1. **Dead Load** – The dead load shall be defined as the weight of the structure and all permanently attached to and supported by the structure.

2. **Live Load** – As designated on the drawings.

3. **Snow Load** – As required per ASCE 7–10, but not less than required by local building codes and/or local amendments.

   Importance Factor (I) = 1.0 or greater per ASCE 7–10 Table 1–1.
   Exposure Factor (C_e) = 1.0 or greater per ASCE 7–10 Table 7–2.
   Thermal Factor (C_t) = 1.2.

4. **Non–Uniform Snow Load** – As required per ASCE 7–10 but not less than required by local building codes and/or local amendments.

5. **Wind Load** – As required per ASCE 7–10, but not less than 157 MPH.

   Exposure Factor = C

6. **Vacuum/Pressure Load** – N/A.

7. **Load Combinations** – As required per ASCE 7–10 Section 2.4.1.

8. **Temperature** – The load combinations listed above shall be considered for a temperature change of 100 degrees F below the installation temperature and 100 degrees F above the installation temperature and for a material temperature range of 40 degrees F below 0 to 160 degrees F above zero.

9. **Panel Design Load** – In addition to the above-mentioned loads and load combinations, the aluminum panels shall be designed for a **300 pound** load distributed over one square foot at any location. This load is to be taken as acting separately and not simultaneously with other design loads.

10. **Deflection** – For the above loads and load combinations, the deflection of all components (structural and cladding) shall not exceed L/240 with L equal to the span of the component. This deflection limit applies not only

to the flat cover as a whole, but also to the decking of the cover spanning between the supporting edges of each panel or module. Calculations stamped by a Georgia registered Professional Engineer shall be provided at the time of submittal to ensure that this requirement has been met.

2.05 MANUFACTURERS

A. The aluminum extruded flat cover shall be as manufactured by TemcorConservatek – Gardena, California (310) 353–5100 or Conroe, Texas (936) 539–1747.

PART 3 – EXECUTION

3.01 INSTALLATION

A. All work shall be executed by skilled mechanics with a supervisor experienced in the erection of extruded flat covers. The flat cover shall be erected plumb and level and in proper alignment.

3.02 WARRANTY

A. The extruded flat cover manufacturer shall warrant that the work described herein shall be free from defects, workmanship and material. The flat cover manufacturer shall replace, or repair only faulty workmanship or defective material furnished by it that is reported to it within one (1) year from the date of completion of this scope of work.

END OF SECTION

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SECTION 44 42 19 – POSITIVE DISPLACEMENT BLOWERS

SECTION 44 42 19

POSITIVE DISPLACEMENT BLOWERS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Division 1 specification Sections, apply to this Section.

B. Additional requirements related to work specified in this Section include, but are not limited to, the following:

Section	Description
45 50 00	Membrane Bioreactor

1.02 SCOPE

A. Provide all labor, materials, tools and equipment required to furnish and install, in good workmanlike manner, Positive-Displacement Rotary 3-lobe blower units with integrated pulsation cancellation. Blower units shall be complete and operational.

B. Blowers(s) shall be designed for continuous duty operation, to provide the air volumes as defined in the Blower Schedules in this Specification.

1.03 QUALITY ASSURANCE

A. Blowers and appurtenances shall be supplied by a CE certified blower manufacturer with a Quality Control System certified in accordance with ISO 9001. Units shall be furnished as a complete system

B. All equipment furnished under this section shall be furnished by a single manufacturer who shall assume complete responsibility for the design and performance of the equipment. The manufacturer shall have a minimum of five (5) years experience in producing blower equipment and shall produce evidence of at least five (5) installations of similar size in satisfactory operation in the United States.

1.04 SUBMITTAL INFORMATION

A. Provide a complete set of submittal information in PDF format. All pertinent information needed to fully describe the blowers(s) and accessories shall be included in the submittal. Where multiple options are included within standard literature, project specific part numbers and options shall be highlighted by enclosing the project-specific information (circling, clouding, text boxes) and other information shall be crossed out. Any deviations to these specifications must be listed on a separate page referencing the specification section with a

brief description of the deviation and why it is equal to or superior to what is specified. Submittals for each size and type shall include, but not be limited to the following:

1. ASME PTC – 9 Performance Test Results
2. Manufacturer of all components supplied
3. Model numbers of all component supplied
4. Rotational speed
5. Capacity in scfm and icfm
6. Discharge pressure
7. dB(A) noise pressure level
8. Weights of each item of equipment
9. Major component materials of construction
10. Blower specification describing construction details
11. HP required at rated capacity and pressure
12. Outline Dimension Drawing
13. Installation Drawing
14. Complete performance data showing capacity and power input
15. Electrical Data that includes
    a. Motor rating, hp
    b. Motor temperature rating
    c. Motor full load rotational speed
    d. Motor full load current
    e. Motor locked rotor current
    f. Motor performance curves showing speed, efficiency, current, power, etc.
16. List of recommended spare parts broken down into on hand parts and long term for 2 years operation and 3 to 5 years operation.
17. Manufacturer's warranty

1.05 OPERATION & MAINTENANCE MANUALS

A. Furnish a complete Installation, Operation & Maintenance Manual in PDF form. Manuals shall include blower and blower package outline dimensions, motor data, nameplate data, safety instructions, transportation and storage information, general design information, mounting & installation information, electrical connection information, commissioning instructions, maintenance information and a trouble shooting guide.

1.06 SPARE PARTS AND TOOLS

A. Provide the following spare parts to the Owner, boxed, marked, and ready for long-term storage:

1. One complete set of gaskets, seals, V-belts, as required for each blower size.

2. One additional set of filter elements for each air inlet filter for each blower size

B. Spare parts shall be properly bound and labeled for easy identification without opening the packaging and suitably protected for long-term storage in a humid environment.

C. One set of Tools required for changing oil and performing belt maintenance shall be provided for each blower size.

PART 2 – PRODUCTS

2.01 BLOWER DESIGN

A. Site Conditions

1. Elevation: 25 feet above sea level

2. Maximum inlet temperature: [95] deg F

3. Maximum humidity (at maximum temperature): [60] %RH

B. Blower Schedules: Blower packages shall be provided to meet to following conditions and duty points.

Blower Name	MBR Zone
Number of Blowers	5 (4 duty and 1 standby)
Maximum Blower Capacity	TBD SCFM
Minimum Blower Capacity	TBD SCFM
Maximum Differential Pressure (excluding internal blower losses)	TBD psig
Indoor/outdoor	outdoor
Hazardous Location	No
VFD Controlled	Yes

Blower Name	Pre-Aeration (Process) Blower
Number of Blowers	TBD
Maximum Blower Capacity	TBD SCFM
Minimum Blower Capacity	TBD SCFM
Maximum Differential Pressure (excluding internal blower losses)	TBD psig
Indoor/outdoor	Outdoor
Hazardous Location	No
VFD Controlled	Yes

Blower Name	WAS/MBT Basin Blowers
Number of Blowers	TBD
Maximum Blower Capacity	TBD SCFM
Minimum Blower Capacity	TBD SCFM
Maximum Differential Pressure (excluding internal blower losses)	TBD psig
Indoor/outdoor	Outdoor
Hazardous Location	No
VFD Controlled	Yes

C. Blowers shall be sized so that maximum duty point does not exceed 90% of maximum blower speed.

D. Blowers shall be rotary-lobe, dynamically and statically balanced, tri-lobe design with an equalization chamber integral to the blower housing.

E. The blower rotors are to be balanced according to ISO 1940 class Q 2.5. With respect to acceptable vibration levels, the blowers must operate between effective vibration speeds of 2.8 to 7.0 mm/sec. (0.11 to 0.276 inches/sec.) measured at the bearing housing per VDI standard 2056. For acceptance, all blowers must conform to ISO 2373, Machine Group T.

F. Each blower shall be factory tested per ASME PTC-9 performance test to verify flow, BHP, and slip at design conditions as well as blower maximum conditions. Slip test only shall not be acceptable. The acceptance criteria are +5% tolerance on power and –5% tolerance on flow regardless of the size of the machine. The performance test can be performed in accordance with other internationally recognized standards, such as ISO.

G. Materials and Construction Features

1. Blower Housing

a. Housing shall be fabricated of close-grained high strength cast iron construction with DIN inlet and outlet connections, provided with a built-in "equalization" chamber, and drive-end head-plate integral to the cylinder.

2. Rotors

   a. Rotors shall be stiff-shaft design with the first lateral critical speed at least 120% of the maximum allowable speed.

   b. Any torsional natural frequency shall be at least 10% above or 10% below the operating speed range of the blower.

   c. The rotor and shaft assembly shall be a one-piece design constructed of ductile iron.

   d. Rotors shall be solid or have closed ends.

   e. Rotors shall have an integral sealing strip for improved efficiency.

3. Timing Gears

   a. Timing gears shall be spur type, precision ground, hardened and carburized, AGMA Grade 11 equivalent quality or better, with minimum service factor of 1.7 at the maximum operating point.

   b. Gears shall be secured by bolting and interference fit on precision ground tapered shaft ends.

4. Bearings

   a. Bearing shall be high standard cylindrical roller bearings with an L-10 Life of at least 40,000 hours at maximum speed and maximum differential pressure.

5. Seals at Rotor Chamber

   a. Rotor chamber seals shall be non-rubbing, vented, labyrinth-type seals. Each seal assembly shall consist of four (4) hardened steel piston rings, an oil deflector, a grooved labyrinth sleeve, and casing wear ring. There are a total of (16) sixteen piston ring seals.

   b. Provision for venting to atmosphere between the oil-side and the air-side seals shall be included.

   c. The use of lip-type seals for internal rotor shaft sealing is not acceptable.

   d. Replaceable casing wear rings to protect the seal bores in the headplates are required.

6. Input Shaft Lip Seal

   a. The input shaft seal shall be a lip type seal

   b. The seal assembly must include a shaft sleeve, precision ground, with a titanium dioxide coating and a relief taper at the dust lip to reduce friction and heat.

c. The seal assembly must be fully serviceable without removing the front oil chamber cover.

2.02 BLOWER PACKAGE

A. Each blower shall be supplied with a sound enclosure covering the entire blower package including the drive motor, the inlet silencer, and the discharge silencer. The sound enclosure must be designed for easy inspection and maintenance of all blower package components. The enclosure shall provide suitable protection for outdoor installation under the specified site conditions.

B. The free field noise pressure at 3 feet from the enclosure shall not exceed [80] dB(A) at the listed operating conditions.

C. The packages shall be driven through V-belts and sheaves. The drive assembly shall be of the high capacity type, oil and heat resistant, with a minimum service factor of 1.5.

D. Automatic tensioning of the V-belts by use of a pivoting, swing frame motor base with adjustable spring assistance and visual indication of V-belt tension shall be provided to insure the V-belts remain properly tensioned with minimal maintenance and to extend V-belt, sheave, and bearing life.

E. The drive guard shall be the manufacturer's standard sheet metal with provision for ventilation. The installed guard shall be fully enclosed, easily removable, and designed to meet current OSHA recommendations and CE standards.

F. The base shall be an elevated, rigid, fabricated steel design with a solid sub-base. The discharge silencer must be integral to the frame in order to minimize space requirements.

G. To prevent transmission of vibration and noise, the base shall include vibration isolators made of rubber in a steel footing. The vibration isolators are to be mounted between the blower base and the package sub-base.

H. Each blower shall be supplied with a combination inlet filter and silencer. Filter element shall be washable by maintenance personnel as a preventative maintenance procedure.

I. Each blower shall be supplied with one inlet silencer. The inlet silencer shall be a combination chamber and absorptive design for maximum sound attenuation. Inlet silencer performance losses shall be included by the blower vendor in the blower performance calculation.

J. Each blower shall be supplied with a discharge silencer. The discharge silencer shall be designed to reduce the pressure noise level emitted by the piping leaving the blower package to 85dB(A) over the entire range of operation, based on a carbon steel, schedule 40 piping of a diameter equal to the blower package nominal connection size.

K. Each blower shall be supplied with a single pressure safety valve on the discharge side of the blower mounted downstream of the discharge silencer and upstream of the check valve. The safety valve shall be set to protect the blower from exceeding its maximum pressure rating. The materials selected for the valve

internals shall enable safe and reliable operation at the site conditions. The single valve shall be sized to pass 100% of the design flow. The valve shall be field adjustable, spring loaded, and have a proportional operating characteristic with respect to the pressure set point.

L. Each blower shall be supplied with one check valve that shall be installed on the discharge line. The vendor shall include the pressure losses produced by the check valve in the blower performance calculation.

M. Each blower package shall be supplied with flexible connector(s) or connection to the plant piping. The flexible connectors shall be sized for a standard, schedule 40 pipe diameter and shall prevent the transmission of noise and vibrations from the blower package into the piping. The flexible connectors shall be suitable for the maximum operating temperature and pressure ratings of the equipment in the air stream.

N. A sound enclosure shall be provided as standard, shipped fully assembled and shall be the product of the blower manufacturer to insure proper integration. The sound enclosure shall be sheet steel construction with powder coat finish. The enclosure shall have hinged and/or removable panels to allow maintenance access. Panels shall incorporate locking closures.

O. The enclosure shall have acoustic foam insulation. The sound absorbing material must be self-extinguishing and meet the standard of UL 94, Section HFI.

P. At a minimum, each blower shall be supplied with the following instrumentation:

1. One pressure gauge to measure the discharge pressure. The pressure gauge shall read 0-15 PSI. The pressure gauge shall have a stainless steel case and be glycerin-filled for pulsation dampening.

2. A filter maintenance indicator.

3. One combination temperature gauge/switch, with adjustable switching point and contact, to measure the discharge temperature. As an option, a separate temperature gauge and switch may be supplied.

Q. Blower Motor

1. All blower motors shall be supplied mounted and aligned within the blower enclosures.

2. Motors shall be 460 volts, 60 Hz, 3 phase.

3. The motors shall have NEMA Class F insulation and limited to Class B rise.

4. The blower motors shall be NEMA Premium efficiency type.

5. Winding Over Temperature Protection

a. Embedded thermostats, one (1) per winding, normally closed contact, shall be provided for an external thermal alarm or motor cut out for all motors 40 Hp and above, unless otherwise shown. Thermal cutout leads shall be brought out to the motor terminal

connection box. Connection of the over-temperature protection to the control system is the responsibility of the Contractor.

6. Blower motors shall have a 1.15 service factor rating. The blower brake horsepower requirements shall not exceed the motor name plate horsepower under the operating conditions listed in the Blower Schedule.

7. Inverter Duty:

   a. All motors for blowers indicated in the Blower Schedule to be powered from variable-frequency alternating-current drives (VFD) shall have the following features in addition to those listed above:

      i Designed for used on pulse width modulated (PWM) VFD without external filters or cable length limitations.

      ii Inverter grade, 1,600 volt, Class F insulation.

      iii Service factor of 1.0 when operated from a VFD.

      iv Meeting requirements of NEMA MG1 Part 31.

R. Blower Enclosure Cooling Fan (when required)

1. When required for the proper functioning of the blower, blower enclosure fan(s) shall be mounted in the sound attenuating enclosure.

2. When blower enclosure fans are motor-operated, each fan shall be driven by a separate motor to ensure adequate cooling at all blower operating speeds.

3. Enclosure cooling fan motors shall be of the same operating voltage as the blower motor.

S. Manufacturer's Warranty

1. The blower manufacturer shall warrant the blower equipment to be of quality construction, free of defects in material and workmanship. A written warranty shall include specific details described below.

2. Rotary blowers shall be warranted against defects in material and workmanship for a period of (60) sixty-months from shipment. All other package components shall be warranted for a period of (18) eighteen months from shipment or (12) twelve months from start-up, whichever occurs first.

T. Manufacturers

1. Aerzen

2. Kaeser

3. Approved equal

PART 3 – EXECUTION

3.01 FACTORY TESTING

A. Manufacturer shall factory-test equipment to detect any defects and demonstrate that they will function satisfactorily under the conditions specified. Testing shall include slip testing and mechanical run testing at full pressure and full speed. Manufacturer shall not supply blowers that do not meet the performance standards

3.02 EXAMINATION

A. Contractor shall off-load equipment at installation site using equipment of sufficient size and design to prevent injury or damage. Immediately after off-loading, contractor shall inspect complete blower package and appurtenances for shipping damage or missing parts. Any damage or discrepancy shall be noted in written claim with shipper prior to accepting delivery. Validate all serial numbers and parts lists with shipping documentation. Notify the manufacturer's representative of any unacceptable conditions noted with shipper.

3.03 INSTALLATION

A. Contractor shall install, level, and align blowers package(s) as indicated on project drawings. Installation must be in accordance with written instructions supplied by the manufacture at time of delivery.

B. Sufficient supports and thrust blocks shall be installed to prevent strain and vibration on blower piping. Install and secure all service lines as required.

3.04 FIELD QUALITY CONTROL

A. Contractor is to inspect the installed blower packages(s) for visual deficiencies

B. Prior to acceptance by owner, an operational test of all blowerss, drives, and control systems shall be conducted to determine if the installed equipment meets the purpose and intent of the specifications. Tests shall demonstrate that all equipment is electrically, mechanically, structurally, and otherwise acceptable; it is safe and in optimum working condition; and conforms to the specified operating characteristics.

3.05 PROTECTION

A. The contractor shall be responsible for provisions to protect the blower package(s) and materials after installation but prior to acceptance by the Owner. Protection of the equipment shall include provisions during installation and testing of nearby piping, valving, or other adjacent equipment. The Contractor shall remove all protective measures installed at completion and acceptance of the project.

END OF SECTION

INDEX TO

SECTION 44 42 46 – SUBMERSIBLE MIXERS

SECTION 44 42 46

SUBMERSIBLE MIXERS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Division 1 specification Sections, apply to this Section.

B. Additional requirements related to work specified in this Section include, but are not limited to, the following:

45 50 00 Membrane Bioreactor

1.02 SCOPE

A. Furnish all labor, materials, tools and equipment necessary for complete installation of submersible mixer(s) described in this Specification.

B. Each mixer shall include a submersible power cable, guide rail system, power cable support, lifting cable, and controls as required in this specification.

C. Mixer(s) shall be designed for continuous duty operation, to provide complete mixing within the basin volumes defined, and to keep solids from settling in the tank.

1.03 QUALITY ASSURANCE

A. The mixer and accessories specified herein shall be the design and fabrication of a single manufacturer which shall have the sole source responsibility for the mixer(s) and associated accessories. The mixer should be supplied by MBR supplier only.

1.04 SUBMITTAL INFORMATION

A. Provide a complete sets of submittal information in PDF format. All pertinent information needed to fully describe the mixer(s) and accessories shall be included in the submittal. Where multiple options are included within standard literature, project specific part numbers and options shall be highlighted by enclosing the project–specific information (circling, clouding, text boxes) and other information shall be crossed out. Any deviations to these specifications must be listed on a separate page referencing the specification section with a brief description of the deviation and why it is equal to or superior to what is specified. Submittals for each size and type shall include, but not be limited to the following:

1. Name of manufacturer.

2. Type and Model.

3. Rotational speed.

4. Major component materials of construction.

5. Mixer specification describing construction details.

6. Outline Dimension Drawing.

7. Installation Drawing.

8. Complete performance data showing capacity and power input.

9. Electrical Data that includes.

   a. Motor rating, HP.

   b. Motor temperature rating.

   c. Motor full load rotational speed.

   d. Motor full load current.

   e. Motor locked rotor current.

   f. Power cable data.

10. Motor performance curves showing speed, efficiency, current, power, etc.

11. Moisture sensor protection characteristics and wiring diagram.

12. Mixer Mast Assembly.

    a. Hoist and Mast Assembly specification.

    b. Hoist details and materials of construction.

    c. Mast assembly details and materials of construction.

1.05 OPERATION & MAINTENANCE MANUALS

A. Furnish a complete Installation, Operation & Maintenance Manual in PDF form. Manuals shall include mixer outline dimensions, motor data, nameplate data, safety instructions, transportation and storage information, general design information, mounting & installation information, electrical connection information, commissioning instructions, maintenance information and a troubleshooting guide.

1.06 SPARE PARTS

A. Furnish one complete set of mechanical, lip and O-ring seals for each mixer type or size furnished. All spare parts shall be provided in a separate container that clearly identifies to which mixer they belong.

PART 2 – PRODUCTS

2.01 MIXER DESIGN

A. Service

1. All mixing equipment shall be designed to satisfactorily operate continuously in a submerged waste treatment plant environment.

2. The mixer(s) shall be designed to be easily raised, lowered, removed for inspection or service, and rotated horizontally without the need for personnel to enter the tank. A single cast sliding guide bracket shall be an integral part of each mixer. The single cast guide bracket shall guide the mixer into position and be capable of carrying the entire weight of the mixer and the maximum loads created by the mixer. The mixer, with its appurtenances and power cable, shall be capable of continuous submergence under water without loss of watertight integrity to a depth of 130 feet. FM–approved mixers have a depth limit of 57 feet.

B. Performance

1. The mixing equipment shall be designed based on the following design conditions and criterion:

Basins Name	**Anaerobic, Anoxic, Post Anoxic Basins**
Number of Basins	3
Fluid to be mixed	RAS, Influent flow, ML
Hazardous Location	No
Solids Concentration (mg/l)	6,000 –15,000
Basin Dia. (ft)	Refer the layout.
Number of Mixers	2- each tank
Minimum SWD (ft)	5
Maximum SWD (ft)	21
Overall Tank Depth (to top of wall, ft)	23

C. General

1. Each mixer shall be of the closed–coupled, direct drive, submersible type design. All components of mixer, including the motor and power cable shall be capable of continuous underwater operation while the mixer propeller is completely submerged. In addition, all components of the mixer shall be capable of operation in air, completely unsubmerged for two hours.

D. Materials

1. Major mixer components shall be of 316 stainless steel construction. All exposed hardware shall be 316 stainless steel. All surfaces coming into

contact with tank fluid other than stainless steel shall be protected by a two–part epoxy paint.

E. Propeller

1. The propeller shall be 316 stainless steel having two or three self–cleaning backward–curved blades capable of handling solids, fibrous materials, heavy sludge and other matter normally found in wastewater treatment applications. Each blade shall be precision–cut and welded to the hub. Propeller shall be dynamically balanced, so the propeller imbalance does not exceed ISO 1940 G6.3 tolerances to prevent excessive vibrations.

F. Fasteners

1. All bolts, nuts, washers and other fasteners shall be 316 stainless steel.

G. Cable Entry

1. The electrical power cable entry shall be an integral part of the slide bracket.

2. The cable entry seal system shall be composed of elastomer grommets flanked by stainless steel washers all designed with close clearance fits against the cable outside diameter and the cable entry inside diameter.

3. A cable entry seal system shall provide a watertight seal between the electrical connection chamber and motor preventing fluid leakage into the motor.

4. Epoxy cable entry sealing systems are not considered equal or acceptable.

H. Shaft

1. The propeller and motor shaft shall be in integral unit. The shaft material shall be 316 stainless steel designed to meet the maximum loads generated by the mixer.

I. Propeller Shaft Seal

1. The mixer shall be provided with a double seal system consisting of a mechanical seal on the propeller (outer) side of the oil chamber and second mechanical seal on the motor (inner) side, each working independently of the other.

2. The mechanical seal shall require neither maintenance nor adjustment, shall not be damaged when the mixer is run dry, shall be easy to check and replace, shall be capable of running in either direction without damage, and be readily available from any major seal manufacturer. Shaft seals that rely on the tank fluid as a lubricant will not be considered acceptable or equal.

J. Bearings

1. The mixer shall rotate on two permanently lubricated bearings. Bearings shall be lubricated for life design and sized to transfer all radial and axial loads to the mixer housing and minimize shaft deflection for increased bearing and seal life.

2. Bearings shall not require pre–loading and shall be maintenance–free with a minimum L10 (B10) bearing life of 100,000 hours at design conditions. Mixer's having bearings that require pre–loading or periodic lubrication will not be considered acceptable or equal.

K. Sealing of Mating Surfaces

1. All mating surfaces of the mixer shall be machined and fitted with static nitrile or viton O–rings providing watertight sealing. Mating surfaces shall be designed to provide watertight seals when metal to metal contact is made resulting in controlled O–ring compression without special torque requirements. No secondary sealing compounds, rectangular gaskets, elliptical O–rings, grease or other devices shall be used as a means of sealing.

L. Motor

1. The multi–pole motor shall be directly connected to the propeller (gearbox designs are not acceptable).

2. The motor shall have a minimum 1.1 service factor, a minimum of 30 feet of power and control cable, be of the squirrel–cage, induction, shell type NEMA B design, housed in an air-filled watertight chamber.

3. Stator winding and leads shall be insulated with moisture resistant Class F insulation, or better, which will resist a temperature of 155 °C (311 °F).

4. The stator shall be dipped and baked three times in Class F varnish.

5. The motor shall be designed for continuous duty, capable of sustaining 10 evenly spaced starts per hour.

6. The rotor bars and short circuit rings shall be constructed of aluminum.

M. Thermal Protection

1. Each phase of the motor shall contain a bi–metallic temperature monitor in the upper portion of the stator windings to monitor stator temperatures. The temperature monitors shall be imbedded in the stator winding coils, connected in series and coupled to the motor contactor coil providing single switch shutdown capability.

2. The temperature setting shall be a minimum of 260 °F and will automatically reset once the stator temperature returns to normal.

3. Temperature monitors shall be used in conjunction with, and supplemental to, external motor overload protection, and wired to the control panel.

N. Moisture Sensor

1. Each mixer shall be equipped with an electrical probe to detect the presence of moisture in the oil chamber before bearing and motor damage occurs.

2. The moisture detection probe will provide the capability for remote monitoring of the state of the moisture probe either by monitoring a dry contact or through the generation of a 24 VAC or 120 VAC discrete signal.

O. Galvanic Corrosion Protection

1. When necessary to prevent galvanic corrosion, the mixer guide bracket shall have a chemical and abrasion resistant polyurethane liner and guide rollers preventing metal to metal contact between the guide bracket and the mounting and support system. Also, a polyurethane bushing shall be provided between the lifting cable shackle and the lifting clamp. The chemical and abrasion resistant liner, rollers and bushing are to provide galvanic corrosion protection by completely separating the mixer from the mounting system.

2.02 MOUNTING AND SUPPORT SYSTEM

A. Power Cable Support

1. A 30–feet–long, ¼–inch diameter, 304 or 316 stainless steel power cable support cable shall be provided with each mixer and be permanently attached to the mixer shackle on one end and the upper guide bracket of the mounting system on the other end. The power cable shall be attached to the support cable using sway clamps at a minimum of five–foot intervals.

B. Lifting Cable

1. A 30–feet–long, ¼–inch diameter, 304 or 316 stainless steel lifting cable shall be provided and attached to the lifting clamp shackle on the mixer. A cable cleat shall be provided to store the cable when needed.

C. Mounting System

1. A mounting system shall be supplied by the mixer manufacturer and used to mount the mixer and guide it during installation and removal without entering or emptying the tank. The upper guide bracket shall have a positioning locking plate and locking pin that securely positions the guide rail system at any position within a 150–degree arc in 15–degree increments without entering or emptying the tank. The mixer shall rest on a stop near the bottom of the tank preventing the mixer blades from contacting the tank floor. A 304–stainless steel mast system shall be used to guide and securely hold the mixer in place and be designed to

withstand the maximum loads produced by the mixer. The mast shall interface with the guide brackets to guide the mixer securely into position.

2. To ensure the integrity of the mounting system the mixer manufacturer shall supply the support guide brackets. The mast may be is supplied by others.

PART 3 - EXECUTION

3.01 FACTORY TESTING

A. The following inspections shall be performed as a routine quality check on each mixer prior to shipment from the factory.

1. Propeller size, motor rating, voltage, phase and frequency shall be checked for compliance with purchase order and specifications.

2. Motor and power cable shall be checked before submergence for insulation damage and the presence of moisture.

3. Pressurize the motor with dry air check for leaks at joints and seals.

4. Before submergence run the mixer to check for correct rotation and ensure mechanical integrity.

5. The mixer shall be submerged in a tank containing water and run completely submerged to check amp readings under load.

6. Motor and power cable shall be checked after submergence for insulation damage and the presence of moisture after removing the mixer from the tank.

B. A quality control check sheet showing that the above testing procedure has been performed and that the mixer successfully passed the tests shall be completed. The quality control check sheet shall be supplied with the final documents.

3.02 EXAMINATION

A. Contractor shall off–load equipment at installation site using equipment of sufficient size and design to prevent injury or damage. Immediately after off–loading, contractor shall inspect complete pump and appurtenances for shipping damage or missing parts. Any damage or discrepancy shall be noted in written claim with shipper prior to accepting delivery. Validate all serial numbers and parts lists with shipping documentation. Notify the manufacturer's representative of any unacceptable conditions noted with shipper.

3.03 INSTALLATION

A. Install, align, and lubricate pump(s) as indicated on project drawings. Installation must be in accordance with written instructions supplied by the manufacture at time of delivery.

3.04 FIELD QUALITY CONTROL

A. Contractor is to inspect the installed mixers(s) for visual deficiencies

B. Prior to acceptance by owner, an operational test of all mixers and control systems shall be conducted to determine if the installed equipment meets the purpose and intent of the specifications. Tests shall demonstrate that all equipment is electrically, mechanically, structurally, and otherwise acceptable; it is safe and in optimum working condition; and conforms to the specified operating characteristics.

3.05 PROTECTION

A. The contractor shall be responsible for provisions to protect the mixers and materials after installation but prior to acceptance by the Owner. Protection of the equipment shall include provisions during installation and testing of nearby piping, valving, or other adjacent equipment. The Contractor shall remove all protective measures installed at completion and acceptance of the project.

END OF SECTION

INDEX TO

SECTION 44 42 56 – PLANT REUSE WATER PUMP STATION

SECTION 44 42 56

PLANT REUSE WATER SYSTEM

PART 1: GENERAL

1.1 SCOPE

To provide a single source responsibility for the manufacture, warranty, service and operation of a prefabricated, skid mounted, fully automatic pumping system for potable water.

A. Pumping system shall conform to the following specifications in all respects.

B. This specification covers minimum requirements; however, it should not be construed as all inclusive.

C. It is the successful vendor's responsibility to include everything necessary to provide a complete, automatic, smooth operating, and reliable pumping system.

D. The manufacturer shall warrant all items supplied by him, whether of his manufacture or of his purchase, per the warranty requirements below.

1. Pass through warranties, warranties provided by manufacturers of purchased equipment included in the pump station, passed through to the owner, shall not be accepted.

2. Pumping system manufacturer shall have a history, covering at least five years, of providing warranties of a single source responsibility nature.

3. On request, pumping system manufacturer shall provide contact information for pumping systems in which the manufacturer has provided this single source responsibility.

E. Manufacturer shall be a US manufacturer, and system shall be manufactured in the USA. All imported pumping systems or pumping systems from foreign manufacturers shall be rejected.

1.2 RELATED SECTIONS

A. Section 01 31 00 - Administrative procedures for start–up, testing and field–testing.

B. Section 33 10 00 Water Utilities

C. Section 25 50 00 – SCADA & Telemetry control systems

E. Section 09 90 00 – Painting

1.3 MANUFACTURER

A. The pumping system shall be model **SFIMC2– 2P360–VTP85**, as manufactured by SyncroFlo, Inc., Norcross, Georgia, U.S.A., as basis of design, operating on **460**–volt **3** phase **60** hertz power. Alternate manufacturer seeking authorization to bid shall be a registered ISO9001:2008 manufacturer, shall hold a current Quality Management Certificate, for the assembly of custom packaged pumping systems accessories and controls for use in commercial, irrigation, municipal, industrial and fire applications.

B. All bids shall be submitted using the SyncroFlo system as base bid. Those bids not using the SyncroFlo system as their base bid will be rejected as non–responsive.

C. For a proposed alternate pumping system to be considered as a post–bid deduct system, the contractor shall furnish the following data in the form of a qualification submittal, in three bound copies with each copy bound as a single document complete with detailed table of contents, and two CDs with the same data in Adobe Acrobat format, to the engineer at least 15 days prior to the date of the bid opening. Qualification submittal shall have been prepared specifically for this project and shall not be a "typical" document that may apply to a number of systems. Qualification submittal shall include a title page stating: project name, project number, owner's name, engineer's name, submitting party's name and contact information, date of submittal, and bid date. Qualification submittal shall include, as a minimum, the following:

1. A complete specification for the pumping system proposed as an equal, including operating sequence, alarm sequence, and bill of materials.
2. A statement of full conformance to the following specifications, including the supplying of the brands of products listed, and to the plans. Statement shall be signed by an officer of the manufacturing firm, and signature shall be notarized.
3. Complete submittal data for all major equipment, as listed in this specification, including properly indicated pump curves.
4. An electrical schematic showing power and control wiring.
5. Complete PLC program listing, properly annotated.
6. Installation list of 20 similar pumping systems which have been in operation for a minimum of 3 years.
7. Location and contact information of closest factory owned and/or trained service centers and date of last factory training session.
8. In order to assure that the manufacturer submitting for pre–approval has in place an acceptable quality assurance program, the manufacturer shall submit copies of their ISO9001:2008 Certificate of Registration, their UL authorization, and their ETL authorization as a part of the qualification submittal.
9. A copy of manufacturer's certificate of insurance showing as a minimum, a general liability coverage of $1,000,000, and an excess liability coverage of $10,000,000.
10. In order to assure that all welding will be accomplished according to ASME standards, copies of all fabricating employees' ASME Section IX pressure vessel certification and AWS D1.1 structural certification shall be included in the qualification submittal.
11. A listing of service department employees authorized for system commissioning and start up, including employee's name and employee number, years of experience starting systems as an employee of the submitting company, contact information, and employee's supervisor's name and contact information.

D. Only if, in the sole opinion of the engineer, the data submitted shows the pumping system to be an acceptable alternate deduct system, shall the bidding contractor be notified not less than 3 days prior to the bid opening date of

acceptance of the submitted equipment as an alternate deduct to the base bid.

E. All bids shall be submitted using the SyncroFlo system as basis of design. Alternate manufacturer, whose pumping system has been preapproved as an alternate deduct, shall be included by addendum as an alternate deduct to the base bid system.

F. Approval of a qualification submittal does not relieve the manufacturer or supplier form providing full and complete submittals if their system is selected, nor does it relieve them of having to conform to these specifications and plans in all respects.

G. Any bids for equipment not previously pre–approved shall be considered as non–responsive and rejected.

H. Requests for substitution of major equipment brand, size, type or function shall be made in writing prior to preparation of the qualification submittal and shall only be included in the submittal and the qualification submittal if previously approved. Otherwise, major equipment shall be as specified in brand, size, type and function as described herein and on the plans. In no wise shall the substitution of the approved alternate piece of major equipment cause the price of the pumping system to increase; however, a significant decrease in price shall be expected and required due to the substitution.

1.4 SUBMITTALS

Within four weeks from award of contract, provide six copies of the submittal for approval, properly dated, sectioned, bound, titled, with a detailed table of contents, including no less than the following:

A. Full set of mechanical drawings including skid dimensioning, connection dimensions, anchor bolt location and typical installation, and equipment layout, all to scale

B. Full electrical schematic, including three–line power schematic, control ladder logic, PLC and SCADA system interface.

C. In order to assure that all welding will be accomplished according to ASME standards, submit copies of all fabricating employees' ASME Section IX pressure vessel certification and AWS D1.1 structural certification. Only those employees with said welding certificates submitted shall weld on the structural or piping portions of the system.

D. Properly indicated pump curves, whose total dynamic head includes pumping system internal losses, manufacturer's name (other than pumping system manufacturer), pump model number, and motor type, RPM and horsepower.

E. Properly marked cut sheets for each major component of the pumping system, both mechanical and electrical.

F. Copies of UL and ETL authorizations for control panels, and for complete pumping system.

G. Manufacturer's current ISO9001:2008 certificate.

H. Complete description of the system including:

1. Submittal schedule,

2. Shipment schedule after receipt of approved submittals,

3. Specification section number relevant to the submittal,
4. Technical information
    a. system model number,
    b. design GPM,
    c. rated suction pressure or lift,
    d. rated discharge pressure,
    e. voltage phase and frequency of required power,
    f. system approximate dry weight
5. Operation sequence,
6. Alarm sequence,
7. Mechanical major component bill of materials,
8. Electrical major component bill of materials,
9. Spare parts list,
10. SCADA interface (if required),
11. Post production features,
12. Notes clarification and exceptions,
13. Receiving instructions,
14. Storage instructions
15. Warranty statement

1.5 OWNER'S MANUALS

A. Operation and maintenance manual shall be provided in two copies to the contractor.

B. Operation and maintenance manual shall have been prepared for this specific project and shall not be a general manual applicable to many systems. Manufacturers' technical manuals shall be included for each piece of equipment that is field serviceable.

C. Manuals shall include the approved submittal and shall be produced in the same format as the submittal, bound in a three–ring binder, with tabbed sections.

D. Manufacturer's manuals shall be included after the submittal pages for each field serviceable device.

E. Components that are serviceable through replacement only shall not have any manuals included. Such components shall include, but shall not necessarily be limited to:

1. Flexible pipe couplings
2. Relays
3. Pressure transducers
4. Pressure switches
5. PLC components

1.6 REFERENCES

A. American Water Works Association (AWWA)

B. American National Standards (ANSI)

C. American Standards for Testing Materials (ASTM)

D. Hydraulic Institute

E. American Society of Mechanical Engineers (ASME)

1.7 CODES

A. Without exception, pumping system shall be UL and ETL listed as finally assembled.

B. Control panel with controls shall be built in accordance to NEC, and U.L and ETL. standards.

1. Without exception, the electrical components and enclosure shall be labeled as a complete U.L. and ETL listed industrial control panel assembly.

2. Manufacturer's U.L. and ETL labels shall be applied to the door.

C. Without exception, pumping system shall be manufactured under the manufacturer's ISO9001:2008 quality assurance program.

1.8 SEQUENCE OF OPERATION

A. General items applying to each alarm circuit shall include a display of condition, the illumination of a red indicating light, and manual or automatic reset of condition.

B. Alarm sequence

1. Low Water Level Alarm. Low water level alarm shall serve to protect the pumps from the adverse effects of running dry. Alarm shall be activated when level in the supply reservoir reaches a critical low level. Alarm shall cause the pumps to be retired in an orderly manner. Alarm shall not be capable of being overridden. Alarm shall not allow any pumps to run, whether in the "Hand" or "Automatic" functions of the selector switch until level has been restored and alarm has been reset. Indication of the alarm shall be displayed visually on the control panel door. Alarm shall be equipped with visual indication and automatic reset.

2. High Discharge Pressure Alarm. High Discharge Pressure alarm circuit shall shut down pumping system if discharge pressure reaches a predetermined high level. Operator interface device (OIT), mounted in enclosure door, shall signal high discharge pressure. Pumping system shall not operate until pressure is reduced and alarm has been reset. Alarm shall be equipped with visual indication and automatic reset.

3. Low Discharge Pressure alarm. Low Discharge Pressure alarm circuit shall shut down pumping system in the event discharge pressure drops below normal level. Operator interface device (OIT), mounted in enclosure door, shall signal low discharge pressure. Pumping system shall operate until

alarm has been manually reset. Alarm shall be equipped with visual indication and manual override.

4. Main phase failure and low voltage safety circuit shall retire the pumping system if it experiences low voltage, phase failure or phase reversal as monitored at line–side of control enclosure. Phase monitor shall have a time delay to allow for transient low voltage during motor starting and to allow maximum motor protection Operator interface device (OIT), mounted in enclosure door, shall signal phase failure for any affected pump.

5. Pump or VFD Failure Alarm. Pump or VFD Failure alarm circuit shall shut down its individual pump and VFD if the VFD detects an overload condition or if the VFD experiences an internal fault. Alarm shall be equipped with visual indication.

6. Plugged Strainer Alarm. Plugged strainer alarm shall shut down pumping system if it experiences a high differential pressure across the automatic and or wye strainers. Alarm shall be able to be reset manually after screen(s) have been cleaned and differential pressure falls below the set–point.

C. Functional Sequence, Pressure and Flow Sequencing

1. Equal sized pumps shall be alternated based on accumulated run time, the pump having the least run time starting as lead.

2. In the event a pump has failed to run or start, or if its switch is turned off, PLC shall shift the pumping sequence to utilize the remaining pumps. Only one pump shall run at a time.

3. Designated pump shall start immediately on a reduction in discharge pressure (10 psid factory default value).

4. PLC shall control pump's VFD to maintain discharge pressure regardless of flow rate.

5. Designated pump shall retire when flow has decreased to zero as maintained for a time (30–45 seconds default value).

1.9 CONTROLS REQUIREMENTS

A. All control enclosures and controls shall have been manufactured on the pumping system manufacturer's site by the pumping system manufacturer.

B. In order to assure complete system integration, Manufacturer, without exception, shall maintain a fully equipped UL and ETL authorized panel shop at his facility under the same roof as the fabrication, painting, and assembly of the mechanical components.

C. Manufacturer, without exception, shall be authorized by Underwriters' Laboratories to label its manufactured control panels as UL Listed under category NITW/NITW7.

D. Manufacturer, without exception, shall conform to the latest edition of NFPA 70 in the manufacturing of its control panels.

E. Manufacturers not conforming fully to these requirements shall have their bids rejected as non–responsive.

PART 2 PRODUCTS

2.1 VERTICAL TURBINE PUMPS

A. Vertical turbine type pumps shall be supplied. The vertical turbine pumps shall be manufactured according to the standards of the Hydraulic Institute and to ANSI specification No. B58.1. Bowl assembly, column pipe, line-shaft, head shaft, and discharge head shall be of U.S. manufacture. The pumping systems manufacturer shall have a network of service centers which shall have available spare parts and trained pump technicians to handle service, repair and warranty procedures.

B. The cast iron discharge head shall have a minimum tensile strength of 30,000 PSI. Pump discharge head shall have a working pressure of not less than 175 PSI and its discharge flange shall conform to ANSI 150 bolt pattern standards. Complete discharge head shall be hydrostatically tested at 200 PSI or greater.

C. A product lubricated high-pressure stuffing box containing a mechanical seal shall be provided. The discharge head stuffing box area shall also include an atmospheric drain port which will be piped off skid. Stuffing box bushing shall be from bearing bronze.

D. The head shaft shall be of the two-piece type, 416 stainless steel and shall be turned and ground. The pump manufacturer shall include a method for adjusting the impeller running clearance at the top of the head shaft. Adequate space shall exist to couple the head shaft and the line shaft above the stuffing box. Coupling shall be extra heavy duty AISI 416 SS.

E. Column pipe should be A53, Grade B schedule 40 material, in inter-changeable sections not more than 5 feet in length. Pump line shaft shall be AISI 416 SS. The size of the shaft shall be no less than determined by ANSI specification B58.1, Section 4.2, Table 4. Bearing retainers shall be bronze with rubber bearings.

F. The pump bowls shall be ASTM A48 Class 30 cast iron free of detrimental defects, glass lined.

G. The enclosed impellers shall be from C83800 bronze. Semi-open type impellers shall not be accepted. Pump shaft shall be AISI 416 SS turned and ground. The shaft shall be supported by bronze bearings above and below each impeller. The suction bell bearing shall be permanently grease packed and sealed with a sand collar.

H. A stainless-steel clip-on type inlet strainer shall be mounted on the bottom of each pump. Inlet area shall not be less than 4 times the suction bell inlet area.

I. For vertical turbine pumps to be operated on VFD, pump submittal shall include calculations showing critical speed calculations for the pumps, and that the line shaft bearing spacing is determined to avoid that critical speed throughout the expected range of pump speed on the VFD.

J. Pump bowl assemblies shall be as manufactured by Peerless.

K. Each pump shall be factory wet pit tested prior to shipment from the pump manufacturer's facility. Shop tests shall prove conclusively that the characteristics of each pump with respect to pressure, duty, capacity, rating, efficiency, performance, function, or special requirements as specified herein comply fully with requirements specified herein and that each pump will operate in the manner specified or implied.

L. Conditions of service:

- Pumping System Estimated Lift: **18'** water column
- Pumping System Estimated Internal Losses: **15'** water column
- Pumping System Discharge Pressure: **85** PSIG

Pump No.	Duty Point	Pump TDH	% Efficiency	Horsepower	RPM
1	400 GPM	230'	84%	40	1800
2	400 GPM	230'	84%	40	1800

2.2 VERTICAL HOLLOW–SHAFT MOTORS:

A. Motors for main pumps shall be high thrust vertical hollow shaft design, WP–I enclosed, shall have a 1.0 service factor when used with PWM, and a 1.15 service factor when used with a sine wave drive, and shall have class F insulation.

B. Motors shall be wound for full voltage starting and shall be suitable for use with a variable frequency drive, conforming to MG1 Part 31.

C. Each motor shall include a steady bushing to be installed around the pump head shaft, set against the hollow shaft of the motor, and securely attached to the head shaft. Installation and attachment shall occur at the time of pump and motor installation.

D. For pump lengths over 20 feet, each motor shall be equipped with a non–reverse ratchet assembly to prevent counter rotation and possible damage to pump components.

E. Maximum pump run out horsepower shall not be greater than motor nameplate rating exclusive of service factor.

F. Motor shall be rated for continuous duty and be designed to carry the maximum thrust load of the pump.

G. Without exception, motors shall be as manufactured by GE or U.S. Electrical Motors.

2.3 AIR VACUUM VALVE

A. Each pump head shall be equipped with a 1" air vacuum valve and isolating ball valve.

B. Valve shall include a stainless–steel float and full-sized orifice.

C. Valve shall be rated at 150 psi working pressure.

D. Valves shall be mounted on the port of the vertical turbine pump head.

E. Air release valve shall be as manufactured by Val–Matic.

2.4 AWWA C504 BUTTERFLY ISOLATION VALVES

A. All isolation valves 3" and larger shall be provided as shown on the contract drawings.

B. Valve shall be manufactured in accordance with the latest revision of AWWA C504, Class 150B (and/or 250B as required) and shall conform to NSF Standard 61.

C. Valve shall be sized for a maximum velocity of 7 fps.

D. Valve shall have one–piece body cast from ASTM A126 Class B cast iron.

E. Stem shall be 304 stainless steel.

F. Disc shall be from ASTM A126 Class B cast iron with a 316–stainless steel edge, lens shaped design, retained by stainless steel pins extending through the stem.

G. Stem bushings shall be self-lubricating non–metallic material.

H. Seat shall be one–piece elastomer, bonded into a recessed cavity in the valve body.

I. Manual actuator shall be of the traveling nut, self locking type and shall be designed to hold the valve in any position intermediate between fully open and fully closed without creeping or fluttering.

J. Valve shall be rated at 150 PSI working pressure.

K. Pump suction isolation valve shall be model 2000 as manufactured by Val–Matic or model 2FII as manufactured by Henry Pratt Company.

2.5 LUG PATTERN BUTTERFLY ISOLATION VALVE

A. Isolation valves in 2 and 2.5" sizes shall be of the lug style butterfly type.

B. Valve shall have one–piece body cast from ASTM A–126 Class B cast iron.

C. Stem shall be from 416 stainless steel.

D. Disc shall be from ASTM A–395; Aluminum Bronze.

E. Stem bushings shall be Duralon to prevent stem seizure to body during prolonged periods of non–use. Stem O–ring shall be from Buna–N.

F. Seat shall be from EPDM elastomer, one–piece construction, and shall also form the flange sealing gaskets.

G. Valves 6" and smaller shall have a lever operator.

H. Valves 8" and larger shall have a gear operator with hand wheel.

I. Valve shall be rated at 200 PSI bubble shutoff.

J. Valve shall be model 31H as manufactured by Bray.

2.6 BALL VALVES

A. Isolation valves shall be provided as full port ball valves in sizes 1.5" and smaller.

B. Valve shall be a two–piece bronze full port ball valve.

C. Valve shall be sized for a maximum velocity of 7 fps.

D. Valve shall have adjustable packing, blow–out proof stem, RPTFE seats and stuffing box ring, hardened ball, and actuator mounting pad.

E. Stem and gland shall be from B16 bronze.

F. Ball shall be chrome plated, from B16 bronze.

G. Retainer and body shall be from B584–C84400 bronze.

H. Body seal shall be from PTFE.

I. Quarter turn manual actuator shall be from zinc plated steel, with Vinyl cover.

J. Valve shall be rated at 600 PSI CWP.

K. Pump isolation valve shall be Apollo model 77–100 as manufactured by Conbraco.

2.7 VIBRATION ISOLATION

A. Flexible Pipe Connectors.

1. Each pump discharge connection shall include a grooved flexible connector, single sphere type, rated at a minimum of 300 psi maximum working pressure for connector sizes through 12".

2. Both wetted and non–wetted elastomeric portions of the flexible connector shall be as manufactured from EPDM.

3. Connectors shall be installed between each pump check valve and its isolation valve.

2.8 CHECK VALVE

Pump check valve shall be provided on the discharge of each pump. Filter check valve shall be provided on the discharge of the automatic filter. Check valve shall be of the silent type. Check valves shall begin to close as forward velocity diminishes and shall be fully closed at zero velocity preventing flow reversal.

A. Valve bodies shall be cast from CAST IRON ASTM A126, CLASS B and shall be free from blow holes, sand holes, and other impurities.

B. Seat shall be as manufactured from BRONZE ASTM B584, ALLOY C83600 and have a Buna–N insert for positive sealing to the disc.

C. Disc shall be as manufactured from BRONZE ASTM B584, ALLOY C83600.

C. Spring shall be as manufactured from STAINLESS STEEL T316, ASTM A313.

D. Bushing shall be as manufactured from BRONZE ASTM B16, ALLOY C36000

E. Retaining screws shall be as manufactured from STAINLESS STEEL T316, ASTM F879.

F. The valve design shall incorporate a center guided, spring loaded poppet, guided at opposite ends, having a short linear stroke that generates a flow area equal to the pipe diameter.

G. Valves shall be sized to permit full pump capacity to discharge through them without exceeding a pressure drop of 6 feet of water column.

H. Check valves through 10" shall be from series 1400BN rated at 400 psi working pressure.

I. Check valves greater than 10" shall be from series 1800BN rated at 200 psi working pressure.

J. Check valves shall be as manufactured by Val–Matic.

2.9 PRESSURE RELIEF VALVE.

A. Pressure relief valve shall be single–seated, diaphragm operated, pilot–controlled, globe or angle valve. It shall be spring loaded & hydraulically operated. Valve spring shall be of stainless steel. Seat ring shall be of stainless steel & readily replaceable with no special tools.

B. Diaphragm assembly shall be fully guided, top and bottom. Diaphragm shall be of nylon reinforced Buna–N synthetic rubber and shall be fully supported by the valve casting in both the full–open and full–closed positions to eliminate strain on the diaphragm. All necessary repairs shall be possible without removing valve from the line. Packing glands are not permitted. Disc shall be synthetic rubber (Buna–N) and have a rectangular cross section. Valve disc and seat shall have an anti–cavitation design of intermeshing orifices to prevent cavitation from discharge pressure to atmosphere.

C. The main valve shall be equipped with the following accessories to ensure proper operation.

1. All control valve pilots shall have stainless steel seats, Buna–N sealing surface and a Buna–N diaphragm. Pilot valve bodies shall be from bronze.

2. Pressure–sustaining pilot shall be sensitive to valve inlet pressure. Pilot shall be normally closed and spring–loaded with spring tension adjustment. Pilot shall open automatically against the spring–loading set when pilot inlet pressure exceeds the set value. This pilot shall function to maintain a minimum valve inlet pressure which shall prevent the pumps from operating under an unstable or overloaded condition.

3. Isolation cocks shall be provided on control tubing at the valve inlet, outlet and bonnet ports on valves 4" and larger. These valves shall be situated such that the control valve may be manually closed & the valve trim isolated and serviced.

4. Strainers shall be provided to remove any solids that may be of sufficient size to damage or plug the pilots and other control components. The inner mesh shall be of MONEL and shall be designed to support the outer screen. The outer screen shall be of 0.008" MONEL wire, having a 40 x 40 mesh.

D. An isolation valve shall be provided at the inlet of the surge anticipator valve, conforming to the requirements of the high–pressure butterfly pump isolation valves specification.

E. Valve may exhaust to atmosphere, or to a or to suction manifold, per the plans.

F. Valve shall be a model 50G–01A as manufactured by Cla–Val Company of Newport Beach, CA.

2.10 SELF–CLEANING FILTER, SAF

Pumping system discharge shall include an automatic self–cleaning SAF filter, as manufactured by Amiad.

A. The SAF filter shall start the self–cleaning process when the pressure differential across the screen reaches a pre–set value or a pre–determined lapse of time. Cleaning of the filter's fine screen shall be carried out by the suction scanner

which shall rotate in a spiral motion while vacuuming the filter cake from the screen and expelling it out through the exhaust valve. During the self-cleaning process, filtered water shall continue to flow downstream.

B. Two types of control boards shall be available for the SAF filters: PLC and Relay.

C. Features:

- Flush according to pressure differential and/or according to time.
- Flush counter.
- Operate an alarm or an alternative malfunction mode indicator

D. Filtration Element: Filter shall include a four-layer, "floating" screen technology. The filter shall offer an effective filtration area than competitive filters which improves their ability to trap and sustain suspended solids, extends the duration between flush intervals, improves back flush efficiency, and overall increase the filters' long-term durability.

E. Cleaning Mechanism: The SAF Suction Scanner cleaning mechanism offers the highest back flush velocity per square inch of any available filter on the market. This superior performance ensures the filter element will be 100 percent clean following each flush with a minimal waste of water.

F. Low Maintenance: The SAF series streamlined automatic, self-cleaning design lowers filter operator maintenance time and cost and provides a simple-to-follow maintenance plan.

G. Customer Support: With more than 40 years of experience in designing, manufacturing and distributing global water filtration systems, Amiad offers customers an unprecedented sales and technical knowledge base. Additionally, its network of sales and technical representatives located throughout North America, guarantees customers timely responses and personal attention.

H. Technical characteristics:

1. Maximum flow rate – 660 GPM
2. Minimum operating pressure – 30 PSI
3. Maximum working pressure – 150 PSI
4. Maximum working temperature – 140°F
5. Flush Reject Volume of filter – 17 Gal
6. Flush cycle – 20 sec.
7. Flush Flow – 48 GPM @ 30 PSI
8. Filter mesh – 200 µ

I. Filter shall include a wafer pattern silent check valve on its outlet and an isolation valve at its inlet and shall include a 460/3/60 control panel.

2.11 WYE STRAINER

A. Pumping system shall include a skid mounted wye strainer, with isolation valves and flex connector, in parallel with the filter.

B. Strainer shall be 6" ANSI 125 flanged and shall be rated at a pressure drop of 0.3 PSI at rated system capacity. Max working pressure shall be 200 PSIG.

C. All parts of the wye strainer shall be accessible for service without removing the strainer from the line.

D. Wye strainer shall include a 60–mesh stainless steel basket.

E. Basket access shall be through a flanged cover, bolted in place.

F. Wye strainer shall be as manufactured by Watts.

2.12 SAMPLE TAP

Sample tap shall be installed with a vacuum breaker to prevent the possibility of cross contamination.

2.13 HOSE BIBB

Hose Bibb shall be installed with a vacuum breaker to prevent the possibility of cross contamination.

2.14 WELDER QUALIFICATION

A. Welders performing structural and pipe welds shall be certified to ASME section IX, and their certificates shall be on file with the manufacturer. Upon request by the engineer or owner, the certificates shall be made available for inspection.

B. All employees welding structural members shall have certificates on file exhibiting conformance to ASME AWS D1.1 structural welding.

c. All equipment including, but not limited to, pumps, motors, valves, instrumentation and controls, shall be mounted on a common structural steel base to form a complete operating pumping system.

D. The pumping system base shall be designed and fabricated to provide proper structural support for all attached equipment if it is supported solely on the peripheral members. Internal members need not contact the floor. This design shall allow the pumping system to be mounted on a slab, a frost wall, or a basement foundation. The base shall supply sufficient rigidity to withstand the stresses of reasonable and competent transportation to site, off loading, installation, and operation.

E. Peripheral structural members shall be from channel or wide flange beam, ASTM A36.

F. Internal structural members shall be from ASTM A36 rectangular tubing or channel.

G. Base shall be of open framework construction, suitable for grouting.

H. All employees welding structural members shall have certificates on file exhibiting conformance to ASME AWS D1.1 structural welding.

I. Provisions shall be made in the station base for off–loading and handling the station at the site.

2.15 STAINLESS STEEL PIPING, 304SS

A. All piping shall be constructed from AISI 304 schedule 40 stainless steel pipe or heavier as required to maintain a 3 to 1 pressure safety factor.

B. Welders performing structural and pipe welds shall be certified to ASME section IX, and their certificates shall be on file with the manufacturer. Upon request by the engineer or owner, the certificates shall be made available for inspection.

C. All piping shall be hydrostatically tested at 150% of maximum shutoff pressure.

2.16 PIPING SUPPORT

A. Piping support shall be manufactured from structural rectangular tubing, sized according to the weight and size of the piping to be supported.

B. Each tubing member shall be capped to prevent internal corrosion.

C. Vertical tubing members shall be solidly welded to the skid and shall support the weight of the piping when filled with water.

D. Horizontal tubing members shall be solidly welded to the vertical members, shall extend beyond the pipe OD, and shall support the weight of the piping when filled with water.

E. Piping shall be secured to the members through the use of piping U bolts designed for this purpose.

F. Thrust of the piping, whether the thrust is in the vertical or horizontal direction, shall be restrained on site by the installing contractor.

2.17 PRESSURE GAUGES

A. A pressure gauge shall be mounted on the discharge header and on the filter discharge, complete with isolation ball valve.

B. Each gauge shall be filled to reduce wear due to vibration.

C. Gauge accuracy shall be within 0.5% and shall comply with ASME B40.1 Grade 2A.

D. Gauge diameter shall be 4.5" minimum.

E. Gauge materials of construction:

1. Connection and bourdon tube shall be from 316 stainless steel.
2. Movement shall be from stainless steel with an internal stop at 1.3 times the gauge range.
3. Dial shall be from white aluminum with black lettering and a stop at the 6 o'clock position.
4. Pointer shall be adjustable from black aluminum.
5. Turret style case shall be from black glass reinforced thermoplastic (PBTP), and shall have built in rear flange lugs, with a solid front and blow–out back, rated at NEMA 4X.
6. Window shall be from acrylic.
7. Window gasket shall be from Buna–N.
8. Filling material shall be glycerin.

F. Range shall be selected so that operating pressure is in the mid range of the gauge.

G. Gauge range shall in no case be less than 20% higher than the highest pressure attainable from the pumps at shutoff head conditions.

H. Gauge shall resist shocks to 100G.

I. Pressure gauge shall be model 233.34 as manufactured by Wika.

2.18 PRESSURE TRANSMITTER

A. Pressure Transmitter shall be mounted on the system discharge, downstream of the filters, and shall provide all pressure signals for the control logic.

B. Pressure Transmitter shall be supplied with an isolating ball valve.

C. Pressure Transmitter shall be a media isolated instrument, having no silicone oil, internal o-rings, or welds.

D. Pressure Transmitter wetted material shall be 17–4PH stainless steel NACE compatible housed in 304 stainless steel having a male threaded process connection.

E. Pressure Transmitter shall provide a 4–20 mA analog output linear with the sensed pressure, from a two wire 10–28 VDC supply, reverse polarity protected.

F. Pressure Transmitter shall have an accuracy of +/- 0.25% BFSL.

G. Resolution of the Transmitter shall be greater than the resolution of the analog to digital conversion for PLC operation.

H. Transmitter shall be rated for pressures greater than station discharge pressure, and shall provide gauge pressure output, rather than absolute pressure.

2.19 LEVEL SWITCH

A. Level switch shall be shipped loose for mounting in the supply sump and shall provide the low-level alarm signal.

B. Level switch shall be a submersible float switch, complete with weight and cable.

C. Transmitter shall be rated for a minimum of 0–30 feet of water column.

2.20 MAGNETIC FLOWMETER

The pumping system shall have a **4"** flow mag-meter installed, which shall be utilized for control and to display the pumping system flow rate, and to display total flow through the pumping system controller operator interface device (OIT). Flow meter shall be electro magnetic flow meter comprised of two major components, a primary head and a signal converter. Flow meter signal converter shall produce two separate signals, pulse and 4–20mA, in linear proportion to flow rate. Flow meter shall read flows from 0–40 fps, with a worst-case inaccuracy of 0.5% of indicated value (not a percentage of full scale) at 1.3 fps or greater. Flows less than 1.3 fps shall have a lower accuracy with accuracy applying to indicated value (not full scale). Flow meter shall be sized so that maximum system flow lies between 16 and 24 fps through the meter. Meter shall be installed according to manufacturer's recommendations. Manufacturer shall have a US based manufacturing and assembly center. Flow meter shall be as manufactured by **Siemens**, without exception.

A. Primary Head: The flow tube shall be a ANSI B16.5 class 150 flanged for sizes less than 24" and AWWA class D flanged for sizes above 24" with a 304SS spool. Wetted liner shall be hard rubber. Liner shall extend beyond the ends of the flow

tube and over the flange faces. Liner shall remain stable and in place under a 500–mBar absolute vacuum or pressure situation. Liner shall be rated for the medium pumped. Magnetic coils shall be wound by the flow meter manufacturer and held in place in such a way as to prevent any fluctuation in the magnetic field generated. Magnetic coils in flow tubes 6" and smaller shall be epoxied together through a fusion bonding process, which renders the magnetic coil a single solid piece with no loose windings. Electrodes shall be from Hastelloy C4. They shall be inserted from the inside of the flow tube and shall be sealed along their length. Electrodes sealed at one or more discrete points shall not be accepted. The wires connecting the electrodes to the primary head shall be fastened in place along their entire length to prevent the transmission of erroneous data or signal noise acquired through signal wire movement. All wiring shall be brought into the primary head connection box and terminated. The shroud protecting the coils and electrodes shall be welded in place, and internally pressure tested to 1.5 atmospheres with air pressure. On completion, the flow tube shall be finish painted on all outside metallic surfaces. Primary head shall be NEMA 6 rated.

B. Signal Converter: The signal converter shall be NEMA 4X rated and shall house the microprocessor–based electronics required for magnet excitation and flow measurement. Functions and data requirements shall be set by either a PC or by a hand–held programmer. Unit shall process flow using a bipolar pulsed DC signal. Power supply shall be 115/230VAC 48–64 Hz. Outputs shall be 4–20 mA and pulsed output scalable at 0–100Hz or 0–1000 Hz for full scale range. Signal converter shall also include a binary output to indicate direction of flow.

C. Grounding rings: Where magnetic flow meters are placed in a pipeline that insulates the water from ground (e.g. epoxy lined steel pipe or plastic pipe) grounding rings are required at both ends of the flow meter to eliminate electrical eddy currents that may exist within the medium being pumped. Grounding rings and flow meter body must be grounded properly., in accordance with manufacturer's recommendations.

D. Calibration and Testing: Meter shall be hydraulically calibrated on a testing device that is at least 10 times more accurate than the meter and shall not be calibrated against a master meter. Each and every flow meter produced by the flow meter manufacturer shall be flow tested and hydraulically calibrated according to this procedure. Manufacturer's test and calibration equipment shall be internationally certified and shall be re–certified every three years. Calibration shall be accomplished through direct volumetric comparison, on rigs certified as having a measurement error of equal to or less than 0.03%. A calibration certificate shall be issued for each and every flow meter produced by the flow meter manufacturer. Calibration certificate shall be traceable to the US National Bureau of Standards. Meters shall be calibrated under standard conditions to a measurement error of less than 0.50% of rate.

E. Best resolution of flowmeter shall be with 5 diameters of straight pipe upstream of the center of the flowmeter, and 2 such diameters downstream of the center of the meter. In space critical situations, the meter manufacturer shall authorize the system manufacturer to attach 90–degree elbows directly to both flanges of the meter, without compromising the accuracy to more than 1% of indicated value (not full scale). Meter manufacturer shall have provided system manufacturer with a written authorization and test data, which shall be kept on file at the system manufacturer's place of business and made available for inspection on request.

F. Stainless steel grounding rings, properly bonded, shall be provided at the inlet and outlet of the flowmeter, when the piping is non–conductive, to arrest any electrical eddy currents in the water that could affect the meter accuracy.

2.21 PAINT

A. Structural steel and supports shall be cleaned then grit–blasted per SSPC–SP6 to commercial blast condition.

B. Primer shall be immediately applied and shall be a two-part epoxy primer.

C. Primer shall be PPG's EPX–900 applied in one coat to 4.0–6.0 mils WFT, or pre–approved equal.

D. Finish coat shall be applied after proper curing time for the primer.

E. Finish coat shall be PPG's AUE–300/301 applied in one coat to 2.7–4.0 mils WFT, or pre–approved equal.

F. Finish coat shall be irrigation green in color.

2.22 BOLTS

All bolts and nuts used in the assembly of the pumping system shall be zinc plated grade 5. As required in specific locations to protect the finish and prevent loosening, bolts shall be provided with washers and lock washers.

2.23 CONTROL ENCLOSURE, WITH AIR CONDITIONER

A. Controls shall be housed in a NEMA 4X **316 stainless steel** enclosure with integral latches.

B. The control enclosure shall be constructed of 14–gauge stainless steel and the back–plate assembly shall be constructed of 12-gauge steel.

C. All indicating lights, reset buttons, selector switches and the operator interface device (OIT) shall be mounted on enclosure door and shall be rated NEMA 4X.

D. All internal components shall be mounted and secured to the removable back plate assembly. All equipment and wiring shall be mounted within the enclosure and labeled for proper identification.

E. All adjustments and maintenance shall be able to be done from the front of the control enclosure.

F. A complete wiring circuit and legend with all terminals, components, and wiring identification shall be provided.

G. Enclosure and internally mounted equipment shall be cooled using a cabinet mounted air conditioner.

H. Air conditioner shall be rated NEMA 4X and shall not allow any air exchange from enclosure external air to internal air.

I. Air conditioner shall be sized to assure adequate removal of all heat with all electrical equipment operating at maximum demand.

2.24 LIGHTNING AND SURGE ARRESTOR

A. Electrical equipment shall be protected by a U.L. 1449 Third Edition Listed SPD to suppress voltage surges on incoming power.

B. SPD shall be connected to the line side of the pumping system landing lugs and shall be properly grounded.

C. The device shall be rated according to IEEE C62.41.1–2002, C62.41.2–2002, and C63.45–2002 to provide a surge capacity of no less than 50kA per phase.

D. Response time shall not be greater than 1 nanosecond.

E. SPD shall withstand no less than 5000 3kA impulses, 8x20µs, or 1000 10kA impulses, 8x20µs.

F. Manufacturer of SPD shall be ISO 9001:2000 certified and shall have an ISO 17025:2005 test lab.

2.25 CIRCUIT BREAKER MAIN DISCONNECT

A. A circuit breaker main disconnect shall be provided to isolate all controls and motor starting equipment from incoming power.

B. UL/CSA short–circuit interrupting capacity rating of the circuit breaker shall be not less than 25,000 amps.

C. Main disconnect shall have a through the door operator and shall be sized in accordance with current NFPA 70 and UL requirements.

D. Disconnect shall be as manufactured by Eaton or Schneider Electric.

E. Disconnect's short circuit rating shall not be less than 25,000 amps.

2.26 CONTROL POWER

A. Power for the controls shall be provided by a control power transformer which shall provide 120–volt, single phase power for the pumping system control operation.

B. Control power transformer shall not be used for any load other than controls.

C. The control power transformer shall be protected on the primary side by control limiting fuses of adequate size and voltage rating.

D. All control components on the load side of the transformer shall be protected by time delay circuit breakers of adequate size.

E. The control power transformer shall be as manufactured by Micron Industries or pre–approved equal.

2.27 CIRCUIT BREAKER VFD DISCONNECT

A. A circuit breaker disconnect shall be provided in the control panel to isolate each VFD from incoming power and provide short circuit protection.

B. UL/CSA short–circuit interrupting capacity rating of the circuit breaker shall be not less than 25,000 amps.

C. Disconnect shall be as manufactured by Eaton or Schneider Electric.

D. Disconnect's short circuit rating shall not be less than 25,000 amps.

2.28 VARIABLE FREQUENCY DRIVE

Variable frequency drives shall be Mitsubishi model F700, without exception.

A. The Drive shall be solid state, with a Pulse Width Modulated (PWM) output. The drive shall utilize the latest isolated gate bipolar transistor (IGBT) technology. VFD must include all of the following features.

B. Control Specifications:

1. Control System – selectable as high carrier frequency PWM control (V/F control), optimum excitation control, and simple magnetic flux vector control
2. Output frequency range – 0.5–400 Hz
3. Frequency Setting Resolution:
   a. Voltage input: 0.015Hz from 0 to 60Hz for 0 to 10V =12bit resolution;
   b. Voltage input: 0.03Hz from 0 to 60Hz 0 to 5V = 11bit resolution;
   c. Milliamp input: 0 to 20mA at approximately 11bit resolution;
   d. Voltage input: –10V to +10V = 11bit resolution;
   e. Voltage input: 0 to ±5V = 10bit resolution.
   f. Digital Input: 0.01Hz
4. Frequency accuracy:
   a. Analog input: Within ±0.2% of the max. output frequency (25°C ± 10°C)
   b. Digital Input: Within 0.01% of the set output frequency
5. Voltage/Frequency Characteristics: Base frequency can be set from 0 to 400Hz. Constant torque/variable torque pattern or adjustable 5 points V/F can be selected.
6. Starting Torque: 120% (3Hz) when set to simple magnetic flux vector control and slip compensation
7. Acceleration/Deceleration Time Setting: 0 to 3600s (acceleration and deceleration can be set individually), linear or S–pattern acceleration/deceleration mode can be selected
8. Stall Prevention Operation Level: Operation current level can be set (0 to 150% adjustable), whether to use the function or not can be selected

C. Operation Specifications:

1. Frequency Setting Signal:
   a. Analog Input: 0 to 10V, 0 to 5V, 4 to 20mA, –10 to +10V, –5 to 5V can be selected.
   b. Digital Input: Four–digit BCD or 16–bit binary using the setting dial of the operation panel (when used with the option FR–A7AX)
2. Start Signal: Available individually for forward and reverse rotation. Start signal automatic self–holding input (3–wire input) can be selected.
3. Operational Functions:
   a. Maximum and minimum frequency settings,
   b. Frequency jump operation,

c. External thermal relay input selection,

d. Polarity reversible operation,

e. Automatic restart after instantaneous power failure operation,

f. Continuous operation at an instantaneous power failure,

g. Commercial power supply–inverter switchover operation,

h. Forward/reverse rotation prevention,

i. Operation mode selection,

j. PID control,

k. Computer link operation (RS–485).

4. Output Signal Selection (Choose up to seven points, one point per function unless otherwise indicated):

a. Inverter running,

b. Up–to–speed,

c. Instantaneous power failure/undervoltage,

d. Overload warning, output frequency detection,

e. Second output frequency detection,

f. Electronic thermal relay function pre–alarm,

g. PU operation mode,

h. Inverter operation ready,

i. Output current detection,

j. Zero current detection,

k. PID lower limit,

l. PID upper limit,

m. PID forward rotation, reverse rotation output,

n. Commercial power supply–inverter switchover MC1,

0. Commercial power supply– inverter switchover MC2,

p. Commercial power supply–inverter switchover MC3,

q. Fan fault output,

r. Heat sink overheat pre–alarm,

s. Inverter running start command on,

t. Deceleration at an instantaneous power failure,

u. PID control activated,

v. During retry,

w. During pid output suspension,

x. Life alarm,

y. Input mc stop signal,

z. Power savings average value update timing,

aa. Current average monitor,

ab. Alarm output 2,

ac. Maintenance timer alarm,

ad. Remote output,

ae. Minor failure output,

af. Alarm output.

ag. Open collector output (5 points),

ah. Relay output (2 points)

ai. Alarm code of the inverter can be output (4 bit) from the open collector.

5. Pulse/Analog Output (select one of the following):

a. Output frequency,

b. Motor current (steady or peak value),

c. Output voltage,

d. Frequency setting value,

e. Running speed,

f. Converter output voltage (steady or peak value),

g. Electronic thermal relay function load factor,

h. Input power,

i. Output power,

j. Load meter,

k. Reference voltage output,

l. Motor load factor,

m. Energy saving effect,

n. PID set value,

o. PID process value, pulse train output

p. AM terminal function selection, analog output

D. Display Specifications:

1. Operating Status:

a. Output frequency,

b. Motor current (steady or peak value),

c. Output voltage,

d. Alarm indication,

e. Frequency setting,

f. Running speed,

g. Converter output voltage (steady or peak value),

h. Electronic thermal load factor,

i. Input voltage,

j. Output voltage,

k. Road meter,

l. Cumulative energization time,

m. Actual operation time,

n. Motor load factor,

o. Cumulative energization power,

p. Power saving effect,

q. Cumulative saving power,

r. PID set point,

s. PID process value,

t. PID deviation value,

u. Inverter I/O terminal monitor,

2. Alarms – displayed when the protective function is activated, and the output voltage/current/frequency/cumulative energization time right before the protection function was activated and the past 8 alarm definitions are selected to be stored.

3. Interactive Guidance – Operation guide and trouble shooting with a help function

E. Protective and Warning Functions:

1. Overcurrent during acceleration,

2. Overcurrent during constant speed,

3. Overcurrent during deceleration,

4. Overvoltage during acceleration,

5. Overvoltage during constant speed,

6. Overvoltage during deceleration,

7. Inverter protection thermal operation,

8. Heat sink overheat,

9. Instantaneous power failure occurrence,

10. Undervoltage,

11. Input phase failure,

12. Motor overload,

13. Output side ground fault overcurrent,

14. Output phase failure,

15. External thermal relay operation,

16. PTC thermistor operation,
17. Option alarm,
18. Parameter error,
19. PU disconnection,
20. Retry count excess,
21. CPU alarm,
22. Power supply short for operation panel,
23. 24vdc power output short,
24. Output current detection value over,
25. Inrush resistance overheat,
26. Communication alarm (inverter),
27. Analog input alarm,
28. Internal circuit alarm (15v power supply),
29. Fan fault,
30. Overcurrent stall prevention,
31. Overvoltage stall prevention,
32. Electronic thermal pre–alarm,
33. PU stop,
34. Maintenance timer alarm,
35. Parameter write error,
36. Copy operation error,
37. Operation panel lock.

F. Environment Requirements:

1. Ambient Temperature: –10°C to +50°C (non–freezing)
2. Ambient Humidity: 90% RH or less (non–condensing)
3. Storage temperature: –20°C to +65°C (applicable for a short period in transit, etc.)
4. Atmosphere: NEMA 1, Plenum rated – Indoors (without corrosive gas, flammable gas, oil mist, dust and dirt, etc.)
5. Altitude: Maximum 1000 meters (3300 feet) MSL
6. Vibration: 5.9m/s^2 or less

G. Variable Torque Ratings: Three phase VFDs are to be derated by 40% for single phase input, three phase output operation. All Mitsubishi F700 VFDs rated for single phase input, three phase output operation have been tested and certified for use on single phase input power.

1. 240-volt, single phase, class: 1/2–75 hp, UL & cUL listed
2. 240-volt class: 1–200 hp at 200–240/3/60
3. 480-volt, single phase, class: 1/2–200 hp, UL & cUL listed

4. 480-volt class: 1–1000 hp at 380–480/3/60

H. Communications protocols:

1. Ethernet I/P
2. **Modbus TCP/IP**
3. BacNET I/P
4. Metasys N2
5. Siemens FLN
6. Modbus RTU
7. BacNET MSTP

I. Harmonics mitigation: Harmonic mitigation shall be in the form of a High Z 5%-line reactor connected between the VFD and its circuit breaker. Line reactor shall have no more than 80 watts heat rejection. Line reactor shall be installed in the control panel.

2.29 MICROPROCESSOR CONTROLS, VARIABLE SPEED

All control logic shall be handled by an industrial microprocessor logic controller accessible through a 7" high definition widescreen graphic operator interface which shall provide data entry and read-out capabilities. Controller shall provide demand controlled sequential pump start up, shutdown and alarm features through its pressure sensing, flow sensing and voltage sensing devices. Controller shall be provided with a built-in memory. Controller shall operate VFDs using dual PID loops, one for acceleration, and one for pressure maintenance. All logic for system control, and timing shall be handled by the controller.

A. Control software shall be parameter driven, fully documented, and allow user to easily change all operational parameters.

B. Conditions that shall be displayed on the controller's operator interface terminal (OIT):

1. Suction Pressure
2. Discharge pressure
3. Current flow rate
4. Total gallons pumped
5. Each alarm on its occurrence, retained until reset.
6. Each pump run time hours and tenths
7. Selection of manual or automatic alternation sequence.
8. Automatic or manual adjustment (selectable) of VFD speed, if pump H–O–A switches are in Auto.

C. Panel face switches and lights:

1. Individual pump run lights – Green LED
2. General alarm light – Red LED
3. Control power on light – White LED
3. Individual pump Hand/Off/Automatic switches

4 Alarm reset pushbutton.

D. All pumping system shutdowns shall be of the controlled type which sequence pumps off at user selectable intervals.

E. 7" high definition widescreen graphic operator interface shall be mounted on the control panel door.

1. This device shall allow the operator to view and modify each register in the PLC.

2. The device shall allow for display and modification of all timer values, set points, lockout times, etc.

F. PLC shall be MicroLogix 1400 as manufactured by Allen Bradley and shall be capable of Ethernet interface to a variety of SCADA platforms.

G. OIT shall be a Maple Systems HMI5070NH color touch screen. Screen shall be protected by a sunshield.

2.30 SCADA INTERFACE

A. SCADA system's connection shall be either hard wired or by Modbus TCP/IP connected to the dedicated terminal strip within the controls enclosure. SCADA connection shall be by the system integrator.

B. Set of auxiliary analog signals including:

1. Suction Pressure (AO)

2. Discharge Pressure (AO)

3. Flow Rate (AO)

C. Set of auxiliary contacts including:

1. Each Pump Call (DI)

2. Each Pump Running (DO)

3. Each Pump Fault (DO)

4. General Alarm (DO)

2.31 SPARE PARTS

A. Spare parts shall be provided as listed below, wrapped or bagged to prevent premature oxidation, and properly identified and boxed.

1. Qty (1) Seal kit with gaskets

2. Qty (1) Set of control panel replacement fuses

3. Qty (1) Set of pilot light replacement lamps

PART 3 EXECUTION

GENERAL.

Installing contractor shall be responsible for providing all materials, equipment, and labor necessary to install and connect the pumping system.

3.1 SYSTEM FACTORY WITNESSED FLOW TEST

The entire pumping system shall be flow tested across its entire range at the manufacturer's facility prior to shipment.

A. Factory flow test rig shall include flowmeter and gauges that are NIST traceable. Test rig shall be able to supply power to the pumping system control panel to support the operation of all pumps.

B. System shall be supplied with the established minimum suction pressure, and adequate flow for test of the pumps.

C. All electrical controls and circuits shall be included in the system test, as shall their interface to the motors and the outputs to the SCADA system.

D. System factory flow test results shall be provided in the form of an X–Y plot.

E. Any failure in the flow test, either for any pump or for the system, shall be corrected by the manufacturer at his expense, and the test repeated until satisfactory results are obtained.

F. Flow test may be witnessed in person. Advise engineer two weeks in advance of flow test to be witnessed in person. Transportation, lodging and per diem expenses shall be for the account of the person(s) witnessing the test in person.

G. Instead of a flow test being witnessed in person, a witness flow test shall be conducted virtually, via the internet, using a portable web cam. Test shall be interactive between the tester and the witness, allowing questions, comments and responses to be communicated while the test is in progress. Advise engineer one week in advance of flow test to be witnessed virtually.

H. Flow test shall be witnessed virtually, via the internet, using a portable web cam. Test shall be interactive between the tester and the witness, allowing questions, comments and responses to be communicated while the test is in progress. Advise engineer one week in advance of flow test to be witnessed virtually.

3.2 UNLOADING AND SETTING SUPERVISION

A. Setting of the pumping system and connection to suction, discharge and power, anchoring of the pumping system, and thrust blocking of the suction and discharge piping that is connected to the pumping system shall be the responsibility of the installing contractor and not the manufacturer.

B. Crane to off–load and set the pumping system onto the concrete slab shall be provided by installing contractor.

C. Manufacturer shall inform the contractor, prior to system shipment, of the calculated weight of the pumping system.

3.3 START UP

A. When discharge piping, electrical connections, and electrical inspection have been completed, the pumping system manufacturer shall be contacted for start up.

B. A minimum one-week notice shall be given to manufacturer prior to scheduled start up date.

C. Field testing:

1. During start up, the complete pumping system shall be inspected for proper installation and shall be given a running test of normal start and stop, and fully loaded operating conditions.
2. During this test, each pump shall demonstrate its ability to operate without undue vibration or overheating and shall demonstrate its general fitness for service.
3. All defects shall be corrected, and adjustments made at the expense of the pumping system manufacturer.
4. Test shall be repeated until satisfactory results are obtained.

D. Start up assistance shall be limited to one day.

E. After the station startup has been completed, but before the technician leaves the job site, a training session shall be given to the owner and/or the owner's representative to familiarize them with the pumping system operation, maintenance and adjustments.

3.4 WARRANTY

A. The manufacturer shall warrant that the water pumping system shall be free of defects in workmanship for a period of one year from date of authorized start–up but not to exceed eighteen months from date of manufacturer's invoice.

B. Provided that all installation and operation responsibilities have been properly performed, manufacturer shall provide a replacement part or component during the warranty life. Any repairs to be accomplished at manufacturer's expense must be pre–authorized. The start–up certificate must be on file with manufacturer to activate warranty. Upon request, manufacturer shall provide advice for trouble shooting of a defect during the warranty period.

C. Manufacturer shall use only first quality material. As with any mechanical or electrical device, some preventive maintenance efforts are required to assure an adequate service life. A periodic preventive maintenance program recommendation shall be included in the owner's manual. Manufacturer shall support a large national network of technical service technicians. Manufacturer's field service technicians shall be contacted for service. Because of varied conditions beyond the control of manufacturer, this warranty may not be valid or may not cover damage as follows:

1. Default of any agreement with manufacturer.
2. Misuse, abuse, or failure to conduct routine maintenance.
3. Handling any liquid other than clean water.
4. Exposure to electrolysis, erosion, or abrasion.
5. Presence of destructive gaseous or chemical solutions.
6. Over voltage or unprotected low voltage.
7. Unprotected electrical phase loss or phase reversal.

END OF SECTION 44 42 56

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SECTION 44 42 73

PRESTRESSED CONCRETE EQUALIZATION STORAGE TANK

SECTION 44 42 73

PRESTRESSED CONCRETE EQ STORAGE TANK

PART 1 – GENERAL

1.1 WORK INCLUDED

A. Pre–stressed Composite Tank.

B. Equalization Pump

C. Course Bubble Diffuser

E. Piping.

F. Instrumentation

G. All necessary appurtenances related to convey sludge from this tank to the existing system as shown on the plans.

H. Site work.

1.2 RELATED WORK

A. Section 31 00 00 – Earthwork

B. Section 03 30 00 – Concrete

C. Section 05 50 00 – Miscellaneous metals

D. Section 09 900 00 – Painting

E. Section 26 05 00 – Electrical

1.3 REFERENCES

A. AWWA Specifications C100, C400, C600, C650, C800, C900 and D100 series (latest revision) shall be used as a guide.

1.4 OPTIONS

A. Where manufacturers of material or equipment are named in the specifications, the Contractor may use equipment or materials of other manufacturers provided they are reviewed and accepted by the Engineer as meeting the specifications.

1.5 QUALITY ASSURANCE

A. Materials – The Contractor will furnish the Engineer and the Owner a description of all material before ordering. The Engineer will review the Contractor's submittals and provide in writing an acceptance or rejection of material.

B. Manufacturer – Material and equipment shall be the standard products of a manufacturer who has manufactured them for a minimum of 2 years and who provides published data on the quality and performance of the products.

C. Tank Manufacturer – The tank shall be manufactured and erected by a tank builder who has designed and built storage tanks for a period of at least five (5) years and who publishes data on the tank he proposes to erect.

D. Subcontractor – A subcontractor for any part of the work must have experience on similar work and if required furnish the Engineer with a list of projects and the names of Owners or Engineers who are familiar with his capability.

E. Tank – The tank shall be a circular prestressed composite tank. Preference will be given to good appearing economical design. The manufacturing and erection of the storage tank shall be in strict accordance with the latest standard specifications for wire–wound circular pre–stressed concrete tanks, adopted by the American Water Works Association except where modified hereinafter. The tank is in a 160 MPH Hurricane Zone. It shall be designed in accordance with AWWA D–110 or latest revisions.

The tank will be designed for Seismic Zone #1. The capacity will be 500,000 gallons at the normal water level.

Devices, equipment, structures, and systems not designed by the Engineer that the Contractor wishes to furnish shall be designed by either a registered professional engineer or by someone the Engineer accepts as qualified. If required, complete design calculations and assumptions shall be furnished to the Engineer or Owner before acceptance.

F. Testing Agencies – Soil Testing shall be done by a testing laboratory which operates in accordance with ASTM E–329–77 (reapproved 1983 or latest revision) by the Engineer prior to engagement. Mill certificates of tests on materials made by the manufacturers will be accepted provided the manufacturer maintains an adequate testing laboratory, makes regularly scheduled tests that are spot checked by an outside laboratory, and furnishes satisfactory certificates with the name of the one making the test. Agencies to be used shall be submitted to the Engineer for review prior to engagement.

Hydrostatic tests on pipe shall be made by the Contractor with equipment qualified by the Engineer. The Engineer or his representative reserves the right to accept or reject testing equipment.

G. Lead Free material – All pipe material, solder and flux shall be lead free (less than .2 percent lead is solder and flux and less than 0.8 percent lead in pipes and fittings).

1.6 REQUIREMENTS OF REGULATORY AGENCIES

A. None required.

All portions of the tank, shall be of water–tight construction.

1.7 PRODUCT DELIVERY, STORAGE & HANDLING

A. Material shall be unloaded in a manner that will avoid damage and shall be stored where it will be protected and will not be hazardous to traffic. The Contractor shall repair any damage caused by the storage. Material shall be examined before installation and neither damaged nor deteriorated material shall be used in the work.

1.8 SEQUENCING, SCHEDULING

A. The Contractor shall submit a schedule showing the start and time required for each element of the work and shall order the material and equipment for delivery to match this schedule.

1.9 ALTERNATIVES

A. The intention of these specifications is to produce the best system for the Owner. If the Contractor suggests that alternate material, equipment or procedures will improve the results at no additional cost, the Engineer and the Owner will examine the suggestion and if it is accepted, it may be used. The basis upon which acceptance of an alternate will be given is its value to the Owner, and not for the convenience of the Contractor.

1.10 GUARANTEE

A. The tank construction company shall guarantee workmanship and materials on the complete structural portion of the tank for a five–year period from data of acceptance of the work. In case leakage or other defects appear within the five–year period, the tank construction company shall promptly repair the tank at its own expense upon written notice by the owner that such defects have been found. Leakage is defined as a stream flow of liquid appearing on the exterior of the tank, the source of which is from the inside of the tank.

To satisfy the five–year guarantee, tank Construction Company shall furnish a one–year performance and payment bond and a written company warranty for an additional four–year period.

On other related construction, the Contractor shall guarantee the quality of the materials, equipment, and workmanship for a period of 12 months after acceptance. Defects discovered during that period shall be repaired by the Contractor at no cost to the Owner. The Performance Bond shall reflect this guarantee.

1.11 EXISTING UTILITIES

A. All known utility facilities are shown schematically on plans and are not necessarily accurate in location as to plan or elevation. Utilities such as service lines or unknown facilities not shown on plans will not relieve the Contractor of his responsibility under this requirement. "Existing Utilities Facilities" means any utility that exists on the project in its original, relocated or newly installed position. The Contractor will be held responsible for the cost of repairs to damaged

underground facilities; even when such facilities are not shown on the plans. The Contractor shall contact all utility companies prior to beginning work and request an accurate field location of their respective utility lines.

1.12 CONNECT NEW MAIN TO EXISTING SYSTEM

A. The Contractor shall furnish the necessary pipe and perform all excavation, dewatering, shoring, backfilling, etc., necessary to make the connection of a new main to the existing water system. The Contractor shall contact the Superintendent of the treatment plant a minimum of 48 hours in advance of construction. The Contractor shall be responsible for coordinating his construction with the utility operator.

1.13 DAMAGE TO EXISTING Utility SYSTEM

A. Damage to any part of the existing system by the Contractor or subcontractors that is repaired by the Utility owner's forces shall be charged to the Contractor on the basis of time and material, plus 30% for overhead and administration.

1.14 MEASUREMENT AND PAYMENT

A. Payment for the work covered by this Section shall be made under the lump sum item "Equalization Storage Tank". Payment shall include the site work, the cost of furnishing and erecting the tank, soil testing, foundations; painting; tank piping; and piping from the tank base elbow to outside the tank as shown on the construction drawings. Partial payments will be paid upon the submission of properly certified invoices.

PART 2 – PRESTRESSED CONCRETE FLOW EQUALIZATION TANK

2.1 SECTION INCLUDES

A. This section specifies the design and construction of an AWWA D110 Type II, wire–wound pre–stressed concrete storage tank with galvanized steel diaphragm complete including all reinforcing, concrete work, accessories, disinfection, and testing directly related to the tank.

B. The tank contractor is responsible for furnishing all labor, materials, tools, and equipment necessary to design and construct the pre–stressed concrete storage tank as indicated on the drawings and as described in this specification.

2.2 RELATED SECTIONS

A. Appendix A – Geotechnical Report

2.3 REFERENCES

A. ACI 117–10 – Specification for Tolerances for Concrete Construction and Materials

B. ACI 301/301M–10 – Specifications for Structural Concrete for Buildings

C. ACI 305R–10 – Guide to Hot Weather Concreting

D. ACI 306R–10 – Guide to Cold Weather Concreting

E. ACI 347R–04 – Guide to Formwork for Concrete

F. ACI 350/350R–06 – Code Requirements for Environmental Engineering Concrete Structures and Commentary

G. ACI 350.3–06 – Seismic Design of Liquid–Containing Concrete Structures and Commentary

H. ACI 372R–03 – Design and Construction of Circular Wire– and Strand–Wrapped Prestressed Concrete Structures

I. ACI 506R–05 – Guide to Shotcrete

J. ACI 506.2–95 – Specification for Materials, Proportioning, and Application of Shotcrete

K. ACI SP4 – Formwork for Concrete

L. ANSI/AWWA D110–04 – Wire– and Strand–Wound, Circular, Prestressed Concrete Water Tanks

M. ASCE Standard 7–10 – Minimum Design Loads for Buildings and Other Structures

N. ASTM A416/A416M–12a – Standard Specification for Steel Strand, Uncoated Seven–Wire for Prestressed Concrete

O. ASTM A615/A615M–12 – Standard Specification for Deformed and Plain Carbon–Steel Bars for Concrete Reinforcement

P. ASTM A653/653M–11 – Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by Hot Dip Process

Q. ASTM A821/A821M–10 – Standard Specification for Steel Wire, Hard Drawn for Prestressing Concrete Tanks

R. ASTM A882/A882M–04(2010) – Standard Specification for Filled Epoxy–Coated Seven–Wire Prestressing Strand

S. ASTM A884/A884M–12 – Standard Specification for Epoxy Coated Steel Wire and Welded Wire Reinforcement

T. ASTM A1064/A1064M–12 – Standard Specification for Carbon Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

U. ASTM C31/C31M–12 – Standard Practice for Making and Curing Concrete Test Specimens in the Field

V. ASTM C33/C33M–13 – Standard Specification for Concrete Aggregates

W. ASTM C39/C39M–12a – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

X. ASTM C143/C143M–12 – Standard Test Method for Slump of Hydraulic–Cement

Y. ASTM C172/C172M–10 – Standard Practice for Sampling Freshly Mixed Concrete

Z. ASTM C231/C231M–10 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

AA. ASTM C881/C881M–10 – Standard Specification for Epoxy–Resin–Base Bonding Systems for Concrete

BB. ASTM D1056–07 – Standard Specification for Flexible Cellular Materials–Sponge or Expanded Rubber

CC. ASTM F593–13 – Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs

DD. "Earthquake Induced Sloshing in Tanks with Insufficient Freeboard" by P.K. Malhotra, Structural Engineering International, IASBSE, 3/2006 pp 222–225

2.4 SUBMITTALS

A. Prequalification Data: Provide prequalification data prior to the bid in accordance with Section 1.5 B. of this specification.

B. Shop Drawings: Provide shop drawings with a minimum size of 18" x 24" with a complete plan, elevation, and sectional views showing critical dimensions as follows:

1. Size, location, and number of all reinforcing bars.
2. Thickness of all parts of the tank structure including floor, core wall, and covercoat.
3. Prestressing schedule including number and placement of prestressing wires on the tank wall and total applied force per foot of wall height.
4. Location and details of all accessories required.

C. Concrete Data: Submit concrete design mixes including ingredient proportions, minimum cementitious content, and water/cementitious ratio in accordance with Section 2.2 and 2.3 of this specification.

D. Design Data: Submit structural calculations for the tank, signed and sealed by a professional engineer in accordance with Section 1.5 A.3 of this specification.

E. Coating Data: Submit color charts for review by the engineer and owner. Once a color is chosen, submit actual drawdown samples for final approval prior to application of coating.

F. Test Reports: Submit concrete strength reports for 7–day and 28–day breaks taken in accordance with the requirements of Section 3.3 A.1.

G. Warranty Document: Submit warranty document in Owner's name in accordance with Section 1.6 A. of this specification.

H. Cleaning Plan: Submit a cleaning plan which complies with Section 3.4 of this specification.

I. Project Record Documents: Record actual location layout and final configuration of tank and accessories on shop drawings and submit to engineer after construction of the tank is complete.

2.5 QUALITY ASSURANCE

A. Qualifications and Experience:

1. Tank Construction Company: The owner desires a firm with five years of experience in the design and construction of ANSI/AWWA D110 Type II wire–wound, circular pre–stressed concrete tanks. The firm constructing the tank shall have designed and built with its own resources, a minimum of three (3) dome–covered pre–stressed concrete tanks of similar size and complexity in the last three years, which meet these specifications and are now providing satisfactory service. A firm meeting this requirement will ensure that the owner's tank is constructed by a company with the organization, technical skill, quality control, reliability, and financial stability to guarantee the tank.
2. Construction: The entire tank, including all portions of the floor, wall, and roof shall be built by the tank construction company, using its own trained personnel and equipment.
3. Design: All design work for the tank shall be performed by a professional engineer with no less than five years of experience in the design and construction of ANSI/AWWA D110 Type II wire–wound, circular prestressed concrete tanks. The professional engineer shall be a full–time staff member of the tank construction company and shall be licensed to work in the state where the project is located.
4. The diaphragm design and epoxy injection procedure shall have been used in the three tanks required in Section 1.5 A.1 of this specification.
5. The following are preapproved as acceptable tank construction companies:

    i. The Crom Corporation, Gainesville, Florida.
    ii. Precon Corporation, Newberry, Florida.

2.6 WARRANTY

A. Provide a warranty document for workmanship and materials on the complete structural portion of the tank for a five–year period from the date of acceptance of the work. In case leakage or other defects appear within the five–year period, the tank construction company shall promptly repair the tank at its own expense upon written notice by the Owner that such defects have been found. Leakage is defined as a stream flow of liquid appearing on the exterior of the tank, the source of which is from the inside of the tank. The tank construction company shall not be responsible for, nor liable for, any subsurface condition. This warranty

shall not apply to any accessory, equipment or product that is not a structural part of the tank and is manufactured by a company other than the tank construction company.

2.7 DESIGN CRITERIA

A. The design shall be in conformance with applicable portions of American Concrete Institute (ACI) 372R Design and Construction of Circular Wire– and Strand–Wrapped Pre–stressed Concrete Structures, ANSI/AWWA D110 Wire– and Strand–Wound, Circular, Pre–stressed Concrete Water Tanks, and currently accepted engineering principles and practices for the design of such structures.

B. The following loadings shall be utilized in the design:

1. Capacity: 1,500,000 Gallons
2. Dimensions: 100 ft. Inside Diameter
   25 ft. Water Depth
3. Fluid Loads: Shall be the weight of all liquid when the reservoir is filled to capacity. The unit weight of the liquid material shall be 62.4 lbs/ft^3.
4. Dead Loads: Consideration shall be given to all permanent imposed loads including concrete and steel.
5. Seismic Loads: Seismic forces and moments resulting from water sloshing and seismic accelerations of the tank wall and water loads shall be calculated in accordance with ACI 350.3 or ANSI/AWWA D110.
6. Soil Pressure: Earth loads shall be determined by rational methods of soil mechanics. Soil pressure shall not be used in the design of the core wall to counteract hydraulic loads or provide residual compression in the wall.
7. Differential Backfill Loads: Forces from differential backfill loads shall be considered in the design and shall be based on the at–rest coefficient. Passive resistance shall not be used to resist differential backfill loads.
8. Wind Loads: Wind loads shall be considered in the design in accordance with ASCE 7.

C. Floor: The design of the floor for the pre–stressed concrete tank shall conform to the following:

1. Concrete membrane floors shall be a minimum of 4 in. thick and have a minimum thickness of 8 in. of concrete over all pipe encasements and around sumps.
2. A minimum percentage of 0.60% reinforcing steel shall be used in the membrane floor. The minimum percentage shall apply to all thickened sections and shall extend a minimum of 2 ft into the adjacent membrane floor.

D. Core wall:

1. The wire–wound, pre–stressed concrete tank core wall shall be designed as a thin shell cylindrical element using shotcrete and an embedded, mechanically bonded, galvanized steel shell diaphragm.

2. The design of the core wall shall take into account appropriate edge restraint. To compensate for bending moments, shrinkage, differential drying, and temperature stresses, the following minimum reinforcing steel shall be incorporated into the design:

   a. The top 2 ft. of core wall shall have not less than 1% circumferential reinforcing.
   b. The bottom 3 ft. of core wall shall have not less than 1% circumferential reinforcing.
   c. Inside Face:

      (1) The inside face of the core wall shall utilize the diaphragm as effective reinforcing.
      (2) Additional vertical and horizontal reinforcing steel bars shall be used as required by design computations.

   d. Outside Face:

      (1) Vertical reinforcing steel in the outside face of the core wall shall be: minimum of #4 bars at 12 in. center to center.
      (2) Additional vertical and horizontal reinforcing steel bars shall be used as required by design computations.

3. The minimum core wall thickness shall be 3½ in.
4. Reinforcing steel used in the core wall shall be designed using a maximum allowable design tensile stress, f_s, of 18,000 psi.
5. Allowable compressive stress in the core wall due to initial prestressing force, f_{gi}, shall be:

   a. 1250 psi + 75t psi/in. with 0.5 f'_{gi} maximum or less (where f'_{gi} is defined as compressive strength at time initial prestressing force is applied and *t* is the thickness of the core wall in inches).
   b. Maximum of 2250 psi.

6. Allowable compressive stress in the core wall due to final prestressing force, f_g, shall be:

   a. 1250 psi + 75t psi/in. with 0.45 f'_g maximum (where f'_g is defined as compressive strength required for final prestressing force and *t* is the thickness of the core wall in inches).
   b. Maximum of 2025 psi.

E. Prestressing:

1. Circumferential prestressing of the tank shall be achieved by the application of cold-drawn, high-carbon steel wire placed under high tension.
2. A substantial allowance shall be made for prestressing losses due to shrinkage and plastic flow in the shotcrete and due to relaxation in the prestressing steel.
3. The prestressing design shall conform to the following minimum requirements:

a. Working stress for the tank wall, fs, shall be a maximum of 115,000 psi.
b. The allowable design tensile stress in the prestressing wire before losses, fsi shall be 145,600 psi or no greater than 0.63 fu, where fu is defined as the ultimate strength of the wire.
c. Areas to be pre–stressed will contain no fewer than 10 wires per foot of wall for 8 gauge and 8 wires per foot of wall for 6 gauge.
d. A maximum of 24 wires per layer per foot for 8 gauge and 20 wires per layer per foot for 6 gauge will be allowed.

F. Wall Openings:

1. When it is necessary for a pipe to pass through the tank wall, the invert of such pipe or sleeve shall be no less than 18 in. above the floor slab. The prestressing wires required at the pipe elevation shall be distributed into circumferential bands immediately above and below the opening to maintain the required prestressing force while leaving an unbanded strip around the entire tank.
2. Unbanded strips shall have a vertical dimension of no more than 36 in. unless an axi–symmetric shell analysis is performed to account for compressive forces plus shear and moments caused by displacement of the pre–stressing wires into adjacent bands.

PART 3 – PRODUCTS

3.1 PERFORMANCE

A. Performance of the materials used in the tank construction shall conform to the minimum requirements of this specification.

B. Substitutions to the materials in this specification may only be made if submitted in writing and approved by the engineer.

3.2 CONCRETE

A. Concrete shall conform to ACI 301/301M.

B. All concrete shall utilize Type I/II Portland cement.

C. A maximum of 25% of cementitious material may be fly ash.

D. Admixtures other than air–entraining and water reducing admixtures will not be permitted unless approved by the engineer.

E. Coarse and fine aggregate shall meet the requirements of ASTM C33/C33M.

F. Concrete mixes used in the construction of the tank shall conform to the following:

G.

Mix	Compressive Strength (psi)	Minimum Cement Content (lbs)	Maximum Aggregate Size (in)	Maximum W/C Ratio	Air Content (%)	Slump (in)
Floor	4000	560	¾	0.45		4"+/–1"

3.3 SHOTCRETE

A. Shotcrete shall conform to the requirements of ACI 506.2 except as modified herein.

B. All shotcrete mixes shall utilize Type I/II cement.

C. A maximum of 25% of cementitious material may be fly ash.

D. All shotcrete in contact with diaphragm or prestressing wire shall be proportioned to consist of not more than three parts sands to one–part Portland cement by weight. All other shotcrete shall be proportioned to consist of not more than four parts sands to one part Portland cement by weight.

E. Admixtures will not contain more than trace amounts of chlorides, fluorides, sulfides or nitrates.

F. Fine aggregate shall meet the requirements of ASTM C33/C33M.

G. Shotcrete mixes used in the tank construction shall conform to the following:

Mix	Compressive Strength (psi)	Maximum W/C Ratio	Air Content (%)	Slump (in)	Fiber Reinforcement (lbs/cyd)
Core Wall	4000	0.42		4"+/–1"	–
Cover coat	4000	0.42		4"+/–1"	

3.4 PRESTRESSED REINFORCEMENT

A. The prestressing wire shall conform to the requirements of ASTM A821/A821M, Type B.

B. The prestressing wire size shall be 0.162 in. (8 gauge), 0.192 in. (6 gauge) or larger, but no larger than 0.250 in.

C. The ultimate tensile strength, fu shall be, 231,000 psi or greater for 8 gauge wire, 222,000 psi or greater for 6 gauge.

D. Splices for horizontal prestressed reinforcement shall be ferrous material compatible with the prestressing reinforcement and shall develop the full strength of the wire.

3.5 NON–PRESTRESSED REINFORCEMENT

A. Non–prestressed mild reinforcing steel shall be new billet steel meeting the requirements of ASTM A615/A615M with a minimum yield strength, f_y, of 60,000 psi.

B. Welded wire reinforcing shall be plain wire conforming to the requirements of ASTM A1064/A1064M with a minimum yield strength, f_y, of 65,000 psi.

3.6 GALVANIZED STEEL DIAPHRAGM

A. The galvanized steel diaphragm used in the construction of the core wall shall be 26 gauge with a minimum thickness of 0.017 in. conforming to the requirements of ASTM A653/A653M. Weight of zinc coating shall be not less than G90 of Table 1 of ASTM A653/A653M.

B. The diaphragm shall be formed with re–entrant angles and erected so that a mechanical key is created between the shotcrete and diaphragm.

C. The diaphragm shall be continuous to within 3 inches of the top and bottom of the wall. Horizontal joints or splices will not be permitted.

D. All vertical joints in the diaphragm shall be rolled seamed, crimped and sealed watertight using epoxy injection.

E. In all tanks designed to use a waterstop at the floor/wall joint, the steel shell diaphragm shall be epoxy bonded to the waterstop.

3.7 PVC WATERSTOPS, BEARING PADS AND SPONGE FILLER

A. Plastic waterstops shall be extruded from an elastomeric plastic material of which the base resin is virgin polyvinyl chloride.

B. The profile and size of the waterstop shall be suitable for the hydrostatic pressure and movements to which it is exposed.

C. Bearing pads used in floor/wall joints shall consist of neoprene, natural rubber or polyvinyl chloride.

D. Sponge filler at the floor/wall joint shall be closed–cell neoprene.

3.8 EPOXY

A. Epoxy Sealants:

1. Epoxy shall conform to the requirements of ASTM C881/C881M.

2. Epoxy used for sealing the diaphragm shall be, Type III, Grade 1, and shall be 100% solids, moisture insensitive, low modulus epoxy.
3. Epoxy used for placing the waterstop shall be Type II, Grade 2, and shall be 100% solids, moisture insensitive, low exotherm epoxy.
4. When pumped, maximum viscosity of the epoxy shall be 10 poises at 77°F.
5. The epoxy sealants used in the tank construction shall be suitable for bonding to concrete, shotcrete, PVC, and steel.

B. Bonding Epoxy:

1. Epoxy resins used for enhancing the bond between fresh concrete and hardened concrete shall conform to the requirements of ASTM C881/C881M.
2. Epoxy resins shall be a two–component, 100% solids, and moisture–insensitive epoxy and shall be Type II, Grade 2.

3.9 SEISMIC RESTRAINT CABLES

A. When required by design, seismic restraint cables shall be seven–wire strand conforming to ASTM A416/A416M.

B. The strand shall be protected with a fusion–bonded, grit–impregnated epoxy coating conforming to ASTM A882/A882M.

C. The minimum yield strength of the seven–wire strand shall be 270,000 psi.

3.10 TANK ACCESSORIES

A. Minimum of one, 1' 5" x 4' 4" rectangular Type 316 stainless steel wall manhole for access to the interior of the tank. The cover shall also be of Type 316 stainless steel. The wall manhole shall be designed to resist hydraulic loading without excessive deflection.

B. Exterior ladder– No need for exterior ladder

C. Interior ladder shall be fabricated from fiberglass shall conform to all applicable OSHA standards. The ladder shall have a safety climbing device manufactured from Type 316 stainless steel as required to meet applicable OSHA standards.

D. Through–wall pipe sleeves shall be Type 316 stainless steel sleeves with neoprene modular seal units.

E. Accessory hardware, unless otherwise noted, shall be Type 316 stainless steel conforming to ASTM F593.

3.11 COATINGS

A. Exterior coating system shall consist of one of the following:

1. Two coats Tnemec Series 156 Enviro–Crete Modified Waterborne Acrylate.
2. Two coats Thoroseal Waterproof Cement–Based Coating.

PART 4 EXECUTION

4.1 EXAMINATION

A. All subgrade elevations shall be verified prior to starting tank construction.

4.2 INSTALLATION

A. Floor:

1. The subgrade shall be prepared by fine grading to ensure proper placement of reinforcing steel with proper bottom cover.
2. A 6–mil polyethylene vapor–barrier shall be placed after subgrade preparation has been completed.
3. Form and screed boards shall be of proper thickness and sufficiently braced to ensure that the floor is constructed within proper thickness tolerances.
4. Plate bolsters shall be used to support reinforcing steel supported directly on the subgrade to ensure positive control of placement of reinforcing steel.
5. The floor shall be vibratory screeded to effect consolidation of concrete and proper encasement of floor reinforcing steel.
6. The floor shall be water cured for a minimum of 7 days after casting.
7. The floor shall receive a light broom finish.

B. Core Wall:

1. The wall shall be constructed utilizing diaphragm and shotcrete with each conforming to the following:

a. Diaphragm Erection:

(1) The diaphragm shall be protected against damage before, during, and after erection. Nail or other holes shall not be made in the diaphragm for erection except in the top 3 inches. Holes shall not be made in the diaphragm except for inserting wall pipes or sleeves, reinforcing steel, bolts, or other special appurtenances. Such penetrations shall be sealed with an epoxy sealant which complies with Section 2.8 Epoxy.

b. Shotcrete

(1) All shotcrete shall be applied by or under direct supervision of experienced nozzlemen certified by the American Concrete Institute (ACI) as outlined in ACI certification publication CP–60.

(2) Each shotcrete layer shall be broomed prior to final set to effect satisfactory bonding of the following layer.

(3) No shotcrete shall be applied to reinforcing steel or diaphragm that is encrusted with overspray.

(4) No less than ⅛ in. thick shotcrete shall separate reinforcing steel and prestressing wire.
(5) The diaphragm shall be encased and protected with no less than 1 in. of shotcrete in all locations.
(6) The interior shotcrete shall receive a light broom finish.

c. Curing:

(1) Interior and exterior portions of the shotcrete wall shall be water cured for a minimum of 7 days or until prestressing is completed.

C. Epoxy Injection:

1. Epoxy injection shall be carried out from bottom to top of wall using a pressure pumping procedure.
2. Epoxy injection shall proceed only after the diaphragm has been fully encased, inside and outside, with shotcrete.

D. Prestressing:

1. The initial tension in each wire shall be read and recorded to verify that the total aggregate force is no less than that required by the design. Averaging or estimating the force of the wire on the wall shall not be considered satisfactory evidence of correct placement of prestressing wires.
2. Placement of the prestressing steel wire shall be in a continuous and uniform helix of such pitch as to provide in each lineal foot of core wall height an initial force and unit compressive force equal to that shown on the design drawings. Splicing of the wire shall be permitted only when completing the application of a full coil of wire or when removing a defective section of wire.
3. Shotcrete shall be used to completely encase each individual wire and to protect it from corrosion. To facilitate this encasement, the clear space between adjacent wires is to be no less than one wire diameter.
4. Prestressing shall be accomplished by a machine capable of continuously inducing a uniform initial tension in the wire before it is positioned on the tank wall. Tension in the wire shall be generated by methods not dependent on cold working or re-drawing of the wire. In determining compliance with design requirements, the aggregate force of all tensioned wires per foot of wall shall be considered rather than the force per individual wire, and such aggregate force shall be no less than that required by the design and as shown on approved drawings.
5. The tank construction company shall supply equipment at the construction site to measure tension in the wire after it is positioned on the tank wall. The stress measuring equipment shall include: electronic direct reading stressometer accurate to within 2%, calibrated dynamometers and a test stand to verify the accuracy of the equipment.
6. After circumferential prestressing wires have been placed, they shall be protected by encasement in shotcrete. This encasement shall completely encapsulate each wire and permanently bond the wire to the tank wall.
7. When multiple layers of wire are required, shotcrete cover between layers shall be no less than ⅛ in. thick.

E. Cover coat:

1. After all circumferential prestressing wires have been placed, a shotcrete cover having a thickness of no less than 1 in. shall be placed over the prestressing wires.
2. Horizontal sections of the wall shall form true circles without flat areas, excessive bumps or hollows.
3. The cover coat shall receive a sliced trowel finish.

F. Wall Openings:

1. All wall pipes, sleeves and manholes passing through the wall shall be sealed to the diaphragm by epoxy injection.

H. Coatings:

1. All coatings shall be applied a minimum of 28 days after final application of concrete or shotcrete.
2. All application procedures for coatings shall be in accordance with manufacturer's recommendations.

4.3 FIELD QUALITY CONTROL

A. Inspection and Testing:

1. Concrete and Shotcrete Testing:

a. Compression Tests:

(1) Compression test specimens shall be taken during construction from the first placement of each class of concrete specified herein and at intervals thereafter as selected by the Engineer to insure continued compliance with these Specifications. At least one set of test specimens shall be made for each 50 yards of concrete/shotcrete placed. Each set of test specimens shall be a minimum of 5 cylinders.

(2) Compression test specimens for concrete/shotcrete shall conform to ASTM C172/C172M for sampling and ASTM C31/C31M for making and curing test cylinders. Test specimens shall be 6–inch diameter by 12–inch high or 4–inch diameter by 8–inch high cylinders.

(3) Compression test shall be performed in accordance with ASTM C39/C39M. Two test cylinders will be tested at 7 days and two at 28 days. The remaining cylinder will be held to verify test results, if needed.

b. Air Content Tests:

(1) Air content tests shall conform to ASTM C231/C231M (Pressure Method for Air Content).

(2) Tests for air content shall be made prior to concrete placement and whenever compression test specimens are made.

c. Slump Tests:

(1) Slump tests shall be made in accordance with ASTM C143/C143M.
(2) Slump tests shall be made whenever compression test specimens are made.

2. Hydrostatic Testing:

a. The tank shall be tested for watertightness upon completion.
b. The testing for watertightness shall be completed as follows:

(1) Fill the tank with water to the maximum water level and let it stand for a minimum of 24 hours.
(2) Inspect the exterior of the tank wall and footing for damp spots. Damp spots shall be defined as spots where moisture can be picked up on a dry hand, the source of which is from inside the tank.
(3) Leakage through the wall or wall–base joint shall be repaired, and the tank shall be retested using the above procedure.

4.4 CLEANING

A. The interior of the tank shall be cleaned to remove debris, construction items, and equipment prior to testing.

END OF SECTION

INDEX TO

SECTION 44 43 34 – INFLUENT DRUM SCREEN

SECTION 44 43 34

INFLUENT DRUM SCREEN

PART 1 – GENERAL

1.1 SCOPE OF WORK

A. There shall be furnished three (3) Model RDS60120DVT Rotoshear PF EZ–Care units, manufactured by Parkson Corporation, Vernon Hills, IL or equivalent pre–approved equal. Each rotating drum screen shall consist of a screen cylinder, base –frame, tub headbox and distribution pan, splash guards, hood and support structure, trunnion wheel assemblies, spray wash system, cylinder stabilizer and positive drive assembly.

The unit shall also be provided with the following optional features: drain pan with support legs, discharge end enclosure with chute and controls.

B. The equipment shall be of the latest design and shall be fabricated of the specified materials and in a fashion, that will fully perform the functions described in these specifications.

1. The screen shall be designed to minimize the time required for routine preventative maintenance. The labor hours presented in the table below define the maintenance requirements. Rotating drum screens that do not meet the following criteria are not acceptable.

Maintenance Item	Maintenance Requirement
Drive System Lubrication	0 hours / year (self-lubricated)
Stabilizer Pad Lubrication	0 hours / year (self-lubricated)

2. The screen shall be designed to facilitate quick and easy replacement of typical wear parts. The labor hours presented in the table below define the maintenance requirements. Rotating drum screens that do not meet the following criteria are not acceptable.

Replacement Item	Replacement Requirement
Chain and Sprocket	2 hours
Trunnion Wheels, Qty 4/unit, For one (1) wheel	0.5 hours
Stabilizer Pad	0.5 hours

1.2 RELATED WORK

A. The following sections apply to the work in this section

1. Wash Press

1.3 REFERENCES STANDARDS

A. The design, manufacture, and installation of this equipment will meet or exceed

the applicable provisions and recommendations of the following current editions of codes and standard authorities, except where otherwise shown or noted:

1. AGMA, American Gear Manufacturers Association
2. ASME, American Society of Mechanical Engineers
3. ASTM, American Society of Testing and Materials
4. ANSI, American National Standards Institute
5. NEC, National Electric Code
6. ABMA, American Bearing Manufacturers Association

1.4 EXPERIENCE

A. The screen manufacturer will have 10 years design and manufacturing experience with internally–fed perforated drum screens, with no less than fifteen (15) similar units installed within the US as screening devices in similar applications.

1.5 PRE–BID SUBMITTALS

A. The screen is the basis of design. Alternative suppliers shall be considered and shall be so named by addendum prior to the bid. To be considered as an equal the alternative supplier shall submit to the engineer the following information at least 21 days prior to the advertised bid date. Complete submittal drawings, quality control and product information will be submitted in electronic and hard copy format, 5 copies required. As a minimum, the following information will be submitted:

1. A Letter of Compliance, which confirms any variances with the Contract Plans and Specifications and provides further explanations where necessary to adequately define the scope of supply.

2. Dimensional plan and section drawings of the equipment mounted in the structure, showing all utility connections and requirements, and anchor bolt locations. Where applicable, drawings will show connection to associated equipment provided by others.

3. Approximate weight of each component or piece of equipment.

4. Manufacturers' catalog information, descriptive literature, specifications, and identifications of material of construction.

5. Power and control wiring diagrams, including terminal layout with numbers, panel construction and panel layout drawings, and control schematics diagrams. Control diagrams will also include a description of operation.

6. Manufacturers' performance data for all drives.

7. Installation, Operation and Maintenance manuals in electronic format for owner review.

1.6 SPARE PARTS

A. No spare parts will be required for the manufacturer as the owner currently maintains required parts in inventory design.

B. Alternative designs shall provide a complete set of drive and driven sprockets or gears as well as drive chains if utilized. One replacement gear reducer with motor. A full set of trunnions with bearings and supports. A full set of spray wash nozzles. Any wear component of the design that will require replacement within the first 5 years of operation.

1.7 BASIS OF DESIGN

A. Equipment Layout: The contract documents and specifications are based on the Parkson manufacturer. Any changes in layout, access platforms, piping or structural requirements for an alternative manufacturer's design will be the responsibility of the installing contractor, including the cost of the engineer to verify layout, sizing, and structural requirements.

B. Standard Designs: Where a manufacturer's standard equipment and/or model number is listed, the equipment shall be provided as modified to conform to the performance, function, features, and materials of construction as specified herein.

1.8 PERFORMANCE AND DESIGN REQUIREMENTS

A. The unit shall be capable of the following performance:

1. The liquid/solids mixture to be screened will be introduced to the internal surface of the screen cylinder with the solids being conveyed to the discharge end of the cylinder by diverters arranged in a helical pattern. Solids discharged out of the cylinder are directed into a collection device. The screened fluid passes through the perforated cylinder and is directed on to the next process.

2. The unit will be installed outdoors, in an unclassified area.

3. The unit's controls will be installed outdoors, in an unclassified area.

4. The unit will be suitable for installation and operation in the designated environment.

5. The unit will be capable of treating a peak flow of **7.5 MGD** per screen with a maximum suspended solids concentration of 250 mg/l without overflow or bypassing.

6. Utilities

a.	External spray wash (@ 80 psi):	23 gpm
b.	Internal spray wash (@ 80 psi):	19 gpm
c.	Power Supply	460 /3/ 60

1.9 WARRANTY

The equipment warranty shall be for a period of one (1) year from being placed into operation, not to exceed 18 months from the date of delivery. The equipment shall be free from defective material and workmanship, under normal use and service and when installed, operated and maintained in accordance with installation instructions, and maintenance/operating procedures.

PART 2 – PRODUCTS

2.1 QUALITY ASSURANCE

1. The equipment shall include all necessary safety devices, such as machinery guards, emergency stops, warning labels, and similar items.

2. Threaded fitting shall have a standard tapered pipe threads complying with ANSI/ASME B1.20.1.

3. Bearings shall conform to the standards of ABMA.

4. Gear reducer selections shall comply with AGMA standards and gear reducer's recommendations.

5. Nameplates shall be engraved stainless steel and stamped and fastened to the equipment with stainless steel rivets.

6. The equipment shall be manufactured in the United States by a manufacturer that is ISO 9001 certified.

7. The equipment shall be factory assembled and tested for a minimum of thirty (30) minutes at the U.S. factory prior to delivery. The Engineer and/or Owner may witness the factory test, at their own option and expense.

8. The equipment shall be delivered to the site as fully assembled as possible. Some components may be removed from the unit after shop testing to prevent damage during shipment' these components must be re–assembled on the unit by the Contractor.

2.2 MATERIALS OF CONSTRUCTION AND FABRICATION

A. Screen Cylinder: The screening element shall be a cylinder constructed of type 316 stainless steel perforated plate, reinforced by a substructure and full continuous internal flight. Each end of the screen element shall be fitted with a type 316 stainless steel end ring welded to the screen substructure throughout the circumference. One end ring shall be considered the drive end and provide the necessary attachment of the drive sprocket. The other end ring shall be considered the discharge end and be designed with an extended bell mouth to provide the effective discharge of dewatered solids away from the base of the unit. The screening cylinder shall measure at a minimum 60" in diameter x 120" in length.

The screening element shall be made of 24 GA (.023 inch) type 316 stainless steel perforated sheet. The sheet shall have 2 mm [0.079 inch] diameter perforations. Each longitudinal end of the perforated sheet shall be bent outward to form a mounting lip. These bends shall not be perforated but shall be provided with a mounting hole pattern to allow the sheets to be fastened to the substructure. Wire mesh screening panels or elements shall not be acceptable.

The substructure shall include four equally spaced longitudinal reinforcing bars welded to the screen end rings. A full continuous flight shall be welded to the interior of the reinforcing bars. The flight shall be made of ¾" diameter type 304 stainless steel pipe, with a pitch of 24.00 inches.

Stainless steel diverters shall be welded to the interior of the end rings to facilitate conveying of screened solids. The diverter height shall be a minimum of 1/2 inch.

B. Base Frame: The base frame of the unit shall be fabricated of type 316 stainless steel. The base frame assembly shall be accurately fabricated to provide a mounting surface for the screen assembly. The frame shall be designed to withstand the loads imposed by the headbox structure and rotating screen cylinder. The base shall also be designed to allow for 4–point support at each corner without undue deflection throughout its length.

C. Tub Headbox and Distribution Pan: The headbox and distribution pan shall be designed to receive the incoming flow and distribute the flow to the screen cylinder.

The incoming flow shall be introduced into the headbox by a 24.00–inch diameter inlet pipe. Inlet piping must be sized to ensure that the flow entering the inlet pipe does not exceed 5 ft/sec. The flow shall be baffled in the headbox to reduce forward velocity and provide momentary flow equalization.

The flow shall be directed from the headbox into the distribution pan, which is cantilevered into the center of the screen cylinder. The pan shall be provided with an open tapered header that controls and equally distributes flow. The final distribution of the flow onto the screen cylinder shall be made by a lexan curved weir located on each side of the distribution pan. Each weir shall have a maximum hydraulic loading not to exceed 36.52 GPM per lineal inch.

The headbox and distribution pan shall be fabricated with minimum 10–gauge type 316 stainless steel components. The headbox shall have a removable stainless–steel cover. The headbox and distribution pan shall be provided with cleanout and drain ports for maintenance purposes.

The influent pipe shall be provided with a type 316 stainless steel face ring and a 24.00–inch nominal diameter type 316 stainless steel loose back–up flange having a 125/150# class flange bolt pattern.

D. Splash Guards: External splash guards shall be designed to contain and direct flow through the base discharge opening. The splash guards shall be constructed of minimum 16–gauge type 316 stainless steel and be fitted on each side of the screening element.

The splash guards shall be fastened on the sides of the hood support structure. The guards shall be designed to be removed for maintenance purposes.

The splash guards shall allow maximum access for routine inspection and maintenance of trunnion wheels, spray bars and all other moving parts.

Access doors with viewing ports shall be provided on the splash guards near the trunnion wheels. Access door shall allow access to the trunnion wheels for routine servicing of the trunnion wheels. Viewing ports shall allow guarded viewing of the operating trunnion wheels for routine inspection.

No access door shall be provided for drive corner trunnion wheel. This trunnion wheel will be accessed through the drive system cover.

E. Hood and Support Structure: A hood shall be supplied to enclose the top of the screen cylinder for misting and odor retention. It shall be fabricated of minimum 14–gauge type 316 stainless steel welded to a support structure. The support structure shall be fabricated of type 316 stainless steel formed structural shapes.

F. Trunnion Wheel Assemblies: The unit shall be provided with four (4) trunnion wheels assemblies. Trunnion wheel assemblies shall be accurately mounted to the base frame to provide positive horizontal placement of the screen cylinder.

1. Trunnion Wheel: Each trunnion wheel shall be constructed of solid polyethylene with an outside diameter of 8 inches. The wheel shall be counter bored for mounting a flanged ball bearing on each side. Flange bearings shall be bolted to each other and to the center of the wheel. Flange bearings shall be sealed and lubricated with oil releasing permanent lubricant, requiring no additional lubrication throughout the life of the bearings.

   Trunnion wheels which require periodic lubrication are not acceptable.

2. Support Shaft: The support shaft shall be of type 316 stainless steel having a minimum diameter of 1–1/2 inches. The shaft shall be mounted in the wheel bearings and accurately positioned and secured by the trunnion wheel support bracket.

3. Trunnion Wheel Support Bracket: The bracket shall be designed to locate the trunnion support shaft and support the loads imposed by the cylinder. The bracket shall include a shaft cradle, which is designed to align and hold the position of the shaft, and to facilitate quick removal and installation of the trunnion wheel and shaft.

   Trunnion wheel brackets without quick release functionality are not acceptable.

4. Trunnion Wheel Replacement Tool: Each screen shall be provided with one removable (1) trunnion wheel replacement tool, which shall lift the screen cylinder when a trunnion wheel requires replacing.

Screens supplied without a trunnion wheel replacement tool are not acceptable.

G. SPRAY WASH SYSTEM

1. External Spray: An external water spray system shall be provided to clean the screen cylinder from the outside. The spray header shall be constructed of a 1–1/2inch Schedule 40 type 316 stainless steel pipe and shall be drilled and tapped to provide the means to mount spray nozzles. Tapped holes shall have a minimum of five (5) effective threads to ensure proper engagement of the nozzles into the header and prevent stripping or galling of the tapped hole threads. Header designs with tapped holes having less than five (5) effective threads are not acceptable. Header consists of 23 Nozzles.

   The nozzles shall be spaced to provide complete coverage of the screen, and spray at an angle of 90 degrees relative to the screen surface to ensure spray penetration through the cylinder openings. The nozzles shall be made of plastic and shall be a quarter–turn quick disconnect design to facilitate easy removal of the nozzle tip for cleaning. Designs without quarter–turn nozzles are excluded due to the risk of thread stripping and galling of the tapped holes or the nozzles.

   The external spray system requires a clean water supply of 23 gpm at 80 psin at the spray header. Clean water must be filtered to a minimum of 60 mesh / 250 micron (filter to be provided by contractor).

2. Internal Spray: An internal water spray system shall be provided to clean the screen cylinder from the inside. The spray header shall be constructed of a 1–1/ inch Schedule 40 type 316 stainless steel pipe and shall be drilled and tapped to provide the means to mount spray nozzles. Tapped holes shall have a minimum of five (5) effective threads to ensure proper engagement of the nozzles into the header and prevent stripping or galling of the tapped hole threads. Header designs with tapped holes having less than five (5) effective threads are not acceptable. Header consists of 19 Nozzles.

   The nozzles shall be spaced to provide complete coverage of the screen, and spray at an angle of approximately 15 degrees below horizontal. The nozzles shall be made of plastic and shall be a quarter–turn quick disconnect design to facilitate easy removal of the nozzle tip for cleaning. Designs without quarter–turn nozzles are excluded due to the risk of thread stripping and galling of the tapped holes or the nozzles.

   The internal spray system requires a clean water supply of 19 gpm at 80 psi at the spray header. Clean water must be filtered to a minimum of 60 mesh / 250 micron (filter to be provided by contractor).

   a. Internal Deflector: An internal deflector shall be provided to cover the internal spray bar assembly. The deflector shall be designed so as not to interfere with the spray pattern yet provide adequate protection from solids that may otherwise accumulate on the

spray bar and nozzles. The deflector shall be constructed of minimum 16–gauge type 304 stainless steel.

H. Cylinder Stabilizer: A cylinder stabilizer assembly will be provided at the discharge end of the screen cylinder to maintain proper cylinder position along the longitudinal axis of the unit.

1. The cylinder stabilizer assembly shall include a plastimeric guide, which straddles the flange on the discharge head of the screen cylinder and limits cylinder movement to +/– 1/8 inch. The replaceable guide shall not require any lubrication.

2. The guide shall be mounted in an easily accessible type 316 stainless steel mounting bracket.

Stabilizer mechanisms that have moving parts, require any type of periodic lubrication, or are mounted under the screen cylinder are not acceptable.

I. POSITIVE DRIVE ASSEMBLY

1. Drive: The unit shall be equipped with a gear reducer and motor to provide rotational motion to the screen cylinder. The screen unit shall be equipped with a 230/460 voltage, 3 Phase, 60 Hz, 2.0 HP motor. The motor shall have a 1.15 service factor and be suitable for use in a severe environment. The motor shall be close coupled to a foot mounted parallel helical gear reducer. The reducer output shaft shall be keyed to accept a drive sprocket and produce an output speed of 27 rpm.

The drive shall be mounted on an adjustable base, which will allow the adjustment needed to maintain proper chain tension.

2. Chain & Sprocket: The screen shall have a chain and sprocket positive drive system that shall eliminate the periodic lubrication requirement.

Screen drive assembly shall consist of a hybrid plastic chain, a hybrid drive sprocket, and a non–metallic driven sprocket. Hybrid assembly of the plastic chain shall minimize the friction coefficient between the sprocket teeth and the chain rollers and eliminate the need for grease or oil lubrication. A drive system that requires periodic lubrication (oil or grease) is not acceptable.

The drive sprocket shall be manufactured in the following three (3) pieces for ease of installation and maintenance:

- Stainless steel hub mounted on the drive output shaft.
- Replaceable non–metallic sprocket plate.
- Stainless steel keeper plate and fasteners.

The design of the drive sprocket assembly shall allow the replacement of the drive sprocket plate without removing the hub from the drive output shaft. This design shall minimize downtime of the unit when replacing the

drive components.

All positive drive system components shall be made of corrosion resistant materials due to the highly corrosive environment. Drive systems made completely of metallic components (carbon steel or stainless steel) that are subject to corrosion and frequent replacements are not acceptable.

J. Discharge End Enclosure: A discharge end enclosure, fabricated of minimum 12–gauge type 316 stainless steel, shall be provided to enclose the discharge end of the screen cylinder, control misting, and direct screenings into a screenings chute or receptacle. The enclosure will be provided with a plain end connection to properly fit up with a chute extension.

A screenings chute extension, fabricated of minimum 12–gauge type 316 stainless steel, shall be provided to direct screenings from the discharge end enclosure into the wash press inlet hopper below. The conveyance tube for screenings from the chute extension to the inlet of the wash press shall be provided by the contractor.

K. Drain Pan and Legs: A drain pan, fabricated of minimum 12–gauge type 316 stainless steel, shall be provided to collect liquid effluent and direct it into the discharge piping (provided by others). The drain pan shall be bolted to the underside of the unit base frame and shall be provided with a 30.00–inch OD bottom pipe connection. The depth of the drain pan shall be sufficient to prevent overflowing at the specified peak flow rate, in a free discharge condition.

The drain pan effluent pipe shall be provided with a type 316L stainless steel face ring and a 30.00–inch nominal diameter type 304 stainless steel loose back–up flange having a 125/150# class flange bolt pattern.

Four (4) support legs shall be provided to elevate the unit and allow proper fit of the drain pan. The support legs shall be constructed of the same material as the base frame.

Drain pan and legs shall be shipped loose for field assembly.

L. Anchor Bolts: Eight (8) Dia 3/4"–10 UNC type 316 stainless steel anchors shall be provided by the installing contractor to secure the screen to the structure. Length shall be decided by installing contractor.

M. Fasteners: All fasteners shall be type 18–8 stainless steel.

N. SURFACE FINISH

1. All stainless-steel sub–assemblies shall be acid passivated after welding for corrosion resistance and to provide a superior surface finish. This shall be done by full dipping of weldments; or by using an acid passivation paste in the weld and heat affected areas and spray–on acid solutions elsewhere. After passivation, the weldments shall be thoroughly rinsed with clean water and allowed to air dry. Sandblasting, sanding, bead blasting, or grit blasting of stainless-steel surfaces will not be allowed in lieu of acid passivation.

2. All carbon steel surfaces shall receive a minimum SSPC–SP6 commercial sandblast treatment. The sandblasted surface shall then receive a minimum of one coat of Carboline Industrial Grade Primer with a minimum of 1.5 mils dry film thickness. The finish shall be a minimum of two coats of Carboline 890 High–Build Epoxy, each coat having a minimum dry film thickness of 2 mils. The finished color shall be black.

3. Motor, gear reducer, bearings and chain shall be provided with the manufacturers' standard finish suitable for a severe environment.

4. Plastic parts shall remain unfinished.

O. ELECTRICAL DEVICES

In addition to the drive motor, the following electrical devices shall be furnished with the unit:

1. Interlock Switch: A NEMA 4X interlock switch shall be fitted on each side splash guard. Interlock switch shall be rated for use in a 120–volt circuit and provided with a 72–inch–long 18/2 lead.

   The unit shall be provided with a total of four (4) interlock switches.

   Each switch shall be wired to the control panel to cause the unit to completely stop rotating upon opening of the guard. Switches shall be powered through intrinsically safe relays in the control panel, which requires wiring in conduit separate from 120–volt wiring. Proper wiring from the switches to the control panel shall be the responsibility of the contractor.

2. Emergency Stop Local Push Button Station: A NEMA 4X polycarbonate emergency stop push button station shall be mounted to the headbox. E–stop will be rated for use in a 120–volt circuit and provided with a 1/2" conduit connection.

   E–Stop shall be wired to the control panel to cause all unit functions to cease upon pressing the E–Stop. Proper wiring from the E–Stop to the control panel shall be the responsibility of the contractor.

3. Spray Solenoid Valve: Slow closing valve shall be provided. While the unit is in operation, each water spray shall be actuated by a normally closed solenoid valve. Each solenoid valve shall have a brass body with 1–1/2" NPT pipe connections.

   Each solenoid valve requires 115–volt, 60 Hz, single phase power and shall be provided with an 18–inch–long 18/3 lead. Electrical housing shall be rated NEMA 4X and provided with a ½" NPT conduit connection. Each solenoid valve shall be field installed by the contractor in the respective wash water supply line. Proper wiring from the solenoid valve to the control panel shall be the responsibility of the contractor.

4. Zero Speed Switch: A zero speed switch shall be provided to detect loss of motion to the screen assembly. The assembly shall consist of the following items:

   A NEMA 4X probe shall be mounted on the unit to receive signals from ferrous blocks mounted to the inlet head of the screen assembly.

   A NEMA 4X amplifier shall receive the signals from the probe and provide alarm contacts for remote indication. Amplifier shall be mounted on the unit.

   Amplifier requires 115–volt, 60 Hz, single phase power. Proper wiring from the amplifier to the control panel shall be the responsibility of the contractor.

2.3 CONTROLS

One control panel shall be provided and shall house the controls for each screen and wash press and have space inside the panel for the future addition of controls for a forth screen and wash press.

A. A 460–volt UL listed primary control panel shall be provided in a NEMA 4X type 316 stainless steel enclosure suitable for wall mounting. It shall contain the following logic devices for proper operation of the equipment for each of the 2 screens:

   1. Programmable relay to monitor equipment mounted electrical devices to perform necessary logic functions.
   2. Main disconnect switch, with door interlock handle.
   3. Soft starter and overload relay and branch circuit protection for 2.0 HP motor.
   4. Motor starter, Non–reversing, with thermal overload relay and branch circuit protection [AWP, 3HP]
   5. E–Stop Push Button (1)
   6. Control Power Indicating Light. (White)
   7. Motor Hand–Off–Auto Selector Switches (2)
   8. Spray Wash Hand–Off–Auto Selector Switches (4)
   9. Screen Fault Lights. (Amber)
   10. Press Fault Lights. (Amber)
   11. System Reset Push button
   12. Running Lights (Red) (2)
   13. Elapsed Time Meters (4)
   14. Current monitor (4)
   15. Auxiliary Contacts for customer use.

B. A main circuit breaker disconnect switch, motor starters and a step–down transformer shall be provided.

2.4 SEQUENCE OF OPERATION (OVERVIEW)

A. Screenings Unit:

   1. Hand Operation: When HAND mode is selected, the unit will run

continuously. When either spray wash HAND mode is selected, the respective spray wash will run continuously.

2. Automatic Operation: The drive motor and spray washes will be controlled automatically when the selector switches are placed in the AUTO position.

   The unit motor starts after the remote customer start contacts closes. It continues to run until the customer start contact opens, then the unit motor will continue to run for an adjustable time period as per the settings on the off–delay timer.

   The external and internal spray solenoids will cycle per the settings on their own repeat timer whenever the unit motor is running.

3. Emergency Stop: The unit can be stopped at any time by pressing either the control panel mounted, or unit mounted Emergency Stop push buttons. The unit will also be stopped whenever the splash guard is opened (as detected by a splash guard interlock switch).
4. FAULTS.

   a. Excessive motor current will trip the starter overload relays, immediately stop the drive motor. This fault must be reset by depressing the motor starter overload reset internal to the control panel.

   b. Excessive momentary motor current will trip the current monitor and immediately stop the drive motor. Pushing the Overcurrent Reset button will reset this fault.

   c. Loss of signal from zero speed switch/Motion failure switch. Pushing the Overcurrent Reset button will reset this fault.

2.5 CONTRACTOR RESPONSIBILITIES

A. The contractor shall be responsible for reviewing the design of the equipment provided by the manufacturer, so that it fits properly in the structure and interfaces properly with associated equipment provided by others.

B. The contractor shall be responsible for receiving the equipment, unloading it from the common carrier, and storing it safely until it is ready to be installed.

C. The contractor shall install the manufacturer's equipment in accordance with the manufacturer's Equipment Drawings and Installation, Operation and Maintenance instructions.

D. The contractor shall provide all field wiring between the electrical devices on the screen (motors, switches, valves, etc.) and the control panel. Contractor shall also provide all required local disconnects and junction boxes.

E. The contractor shall provide all field piping, fittings, isolation valves, gauges (0 to 100 psi), strainers/filters (at each spray header) and any other components necessary for a complete and functional water spray system, which supplies the

required spray water detailed.

PART 3 – EXECUTION

3.1 FACTORY ASSEMBLY, TESTING AND INSPECTION

The equipment shall be factory assembled, operated and inspected prior to shipment to insure the proper interface, and adjustment of all parts. The main control panel shall also be factory tested prior to shipment. Contractor shall install the Drain pan on–site.

3.2 INITIAL START–UP AND TRAINING

A. The contractor shall provide the service of a factory–employed service technician who will adequately inspect the installation, test the equipment furnished under this contract and instruct the owner's operating personnel in its maintenance and operation.

B. The screen and wash press manufacturer shall provide factory service during One (1) trip of two (2) days for inspection of installation, and (1) trip of two days for equipment start up and operator training.

C. The screen shall also be field tested after erection in the presence of the owner and engineer to confirm and verify the structural and mechanical compliance to the specification. The field acceptance test shall include demonstrating that the drum screen operates continuously without vibration, jamming or overheating and performs its specified function satisfactorily.

3.3 INSTALLATION, OPERATION AND MAINTENANCE MANUAL

Five hard copies of the Installation, Operation and Maintenance Manuals are required, a spare manual shall be shipped with the unit to allow for proper operation of equipment prior to release of all final Installation, Operation and Maintenance Manuals to the end user.

A complete electronic O&M manual shall be supplied in addition to the hard copy manuals. This manual shall be electronically searchable. The electronic manual shall be in pdf format.

END OF SECTION 44 43 34

SECTION 44 43 34.1

SCREENING WASHER/COMPACTOR

SECTION 44 43 34.1

SCREENINGS WASHER / COMPACTOR

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. The contractor shall furnish three (3) screenings washer compactors, one for each drum screen. The basis of design is around model AWP8–2.0 Aqua WashPress units, as supplied by Parkson Corp., Vernon Hills, IL, or engineer approved equal. The wash press unit shall consist of a Main Body, Screw, Wash Sprays, Flush Sprays, Drive System, Feed Hopper and Covers, Discharge Piping and Controls.

B. The equipment shall be of the latest design and shall be fabricated of the specified materials and in a fashion that shall fully perform the functions described in these specifications.

C. The units shall be supplied by the manufacturer of the Drum Screens to insure uniformity and seamless operation of the equipment.

1.2 REFERENCES STANDARDS

A. The design, manufacture, and installation of this equipment shall meet or exceed the applicable provisions and recommendations of the following current editions of codes and standard authorities, except where otherwise shown or noted:

1. AGMA, American Gear Manufacturers Association
2. ASME, American Society of Mechanical Engineers
3. ASTM, American Society of Testing and Materials
4. ANSI, American National Standards Institute
5. NEC, National Electric Code
6. ABMA, American Bearing Manufacturers Association

1.3 EXPERIENCE

A. The equipment manufacturer shall have a minimum of ten (10) years of design and manufacturing experience with screw wash press units, with not less than one-hundred (100) screw wash press units sold and installed in similar applications in the United States.

1.4 PRE-BID SUBMITTALS

A. The aforementioned screen is the basis of design. Alternative suppliers shall be considered and shall be so named by addendum prior to the bid. In order to be considered as an equal the alternative supplier shall submit to the engineer the following information at least 21 days prior to the advertised bid date. Complete submittal drawings, quality control and product information shall be submitted in electronic and hard copy format, 5 copies required. As a minimum, the following information will be submitted:

1. A Letter of Compliance, which confirms any variances with the Contract Plans and Specifications and provides further explanations where necessary to adequately define the scope of supply.

2. Dimensional plan and section drawings of the equipment mounted in the structure, showing all utility connections and requirements, and anchor bolt locations. Where applicable, drawings will show connection to associated equipment provided by others.

3. Approximate weight of each component or piece of equipment.

4. Manufacturers' catalog information, descriptive literature, specifications, and identifications of material of construction.

5. Power and control wiring diagrams, including terminal layout with numbers, panel construction and panel layout drawings, and control schematics diagrams. Control diagrams will also include a description of operation.

6. Manufacturers' performance data for all drives.

7. Installation, Operation and Maintenance manuals in electronic format for owner's review.

1.5 SPARE PARTS

A. No spare parts are required for the Parkson design equipment. For other pre-approved suppliers, a complete set of brushes, wear strips and spray nozzles shall be supplied.

1.6 BASIS OF DESIGN

A. EQUIPMENT LAYOUT. The contract documents and specifications are based on the Parkson Aqua WashPress Model AWP8-2.0 design. Any changes in layout, access platforms, piping or structural requirements for an alternative manufacturer's design shall be the responsibility of the installing contractor, including the cost of the engineer to verify layout, sizing, and structural requirements.

The unit shall be inclined at 0 degrees from horizontal. The discharge piping shall be designed to direct the screenings from the unit into the designated receptacle or receiving equipment.

B. STANDARD DESIGNS. Where a manufacturer's standard equipment and/or model number is listed, the equipment shall be provided as modified to conform to the performance, function, features, and materials of construction as specified herein.

1.7 PERFORMANCE REQUIREMENTS

A. The unit shall be capable of the following performance:

1. The unit shall be designed to receive and wash screenings, then reduce the volume and water content by means of a pressing action. Screenings to be washed shall be gravity fed to the drainage trough and conveyed by the screw towards the washing section. Wash water is added, which back flows the screenings, while the spiral alternately stops and restarts to convey the screenings through the wash section. The wash water is then turned off and the screenings are discharged and dewatered by the backpressure generated in the discharge pipe.

2. The unit shall be installed outdoors in an unclassified area.

3. The unit's controls shall be installed outdoors in an unclassified.

4. The unit shall be suitable for installation and operation in the designated space.

5. The unit shall have an inlet capacity of 35 cubic feet per hour, handling wet screenings with an approximate dry weight of not less than 8% solids.

6. Utilities

   a. Total Spray wash (max @ 60 psi):15 gpm (Wash water to be filtered to 50 microns by contractor.) See also sections 2.3, C & D.

   b. Power Supply 460 / 3/ 60 (total power demand indicated on Control Panel drawings)

1.8 WARRANTY

A. The equipment warranty shall be for a period of one (1) year from being placed into operation, not to exceed 18 months from the date of delivery. The equipment shall be free from defective material and workmanship, under normal use and service and when installed, operated and maintained in accordance with installation instructions, and maintenance/operating procedures.

PART 2 - PRODUCT

2.1 QUALITY ASSURANCE

A. The equipment shall include all necessary devices, such as machinery guards, emergency stops, warning labels, and similar items.

B. Threaded fitting shall have a standard tapered pipe threads complying with ANSI/ASME B1.20.1.

C. Bearings shall conform to the standards of ABMA.

D. Gear reducer selections shall comply with AGMA standards and gear reducer's recommendations.

E. Nameplates shall be engraved stainless steel and stamped and fastened to the equipment with stainless steel rivets.

F. The equipment shall be manufactured in the United States by a manufacturer that is ISO 9001 certified.

G. The equipment shall be factory assembled and tested for a minimum of one half (1/2) hour at the U.S. factory prior to delivery. The Engineer and/or Owner may witness the factory test, at their own option and expense.

H. The equipment shall be delivered to the site as fully assembled as possible. Some components may be removed from the unit after shop testing to prevent damage during shipment' these components must be re-assembled on the unit by the Contractor.

2.1 MATERIALS OF CONSTRUCTION AND FABRICATION

A. MAIN BODY- The main body shall consist of a drainage trough and a washer barrel, enclosed by an outer housing and a support leg at each end. The main body shall be constructed of type 316 stainless steel for all welded components, to minimize corrosion in the heat affected zones, and type 316 stainless steel for all non-welded components.

B. DRAINAGE TROUGH. The drainage trough shall be the perforated inlet area of the unit, which captures screenings and allows liquid to drain. The inlet area shall measure 11" wide x 27" long. The drainage trough shall be constructed from 12 gauge (0.11") stainless steel with 0.125-inch diameter perforations.

C. WASHER BARREL. The washer barrel shall provide a washing zone and a dewatering zone for the incoming screenings. The washer barrel shall be constructed of 0.25-inch-thick stainless steel, with three distinct perforated drainage zones having 0.125-inch diameter holes chamfered to 0.334-inch diameter on the outside. The inside of the washer barrel shall be provided with six (6) 0.25-inch-thick by 1.50-inch-wide replaceable wear bars with 400 Brinnel hardness.

D. OUTER HOUSING. The outer housing shall enclose the sides and bottom of the drainage trough and washer barrel. The outer housing shall collect drained liquid from the drainage trough and washer barrel and direct the liquid to a 4.0-inch drain tube. Access panels shall be provided on the outer housing in the washer barrel area to facilitate servicing of the washer barrel. The outer housing shall be constructed from 10 gauge (0.135 inch) thick stainless steel.

E. SUPPORT LEGS. A support leg shall be provided at each end of the main body to support the main body, provide the means to mount the drive assembly (at the drive end), and provide the means to mount discharge piping (at the discharge end). Each support leg shall be designed to allow the screw to be removed from either end of the main body. Each support leg shall be provided with a footpad and anchor bolt holes, to secure the unit to the structure.

F. SCREW: The shafted screw shall be provided to convey screenings through the various stages of the unit. The screw shall be constructed of carbon steel and finished with enamel paint. The spiral shall be 8.00 inches OD and have minimum 0.63-inch thick flights. A replaceable 0.25-inch wide nylon brush with a stainless-steel casing shall be attached with bolted clips to the spiral OD throughout the inlet area to scour the perforated sheet. The brush OD shall be 8.50 inches.

WASH SPRAYS

G. The wash zone shall include a spray wash system to wash organic residue from screenings. The wash zone spray shall consist of one (1) spray header, four (4) water injection points, one (1) ball valve and one (1) solenoid valve. The solenoid valve body shall be of Brass construction with Buna seals. The ball valve shall be of brass construction with a stainless-steel ball. The system shall have an output of 10 GPM at 60 psi. The spray connection shall be ½ inch NPT.

H. FLUSH SPRAYS

The press shall include a single point spray wash system to flush organic residue trapped in the outer trough. The flushing spray shall consist of one (1) spray header, one (1) ball valve and one (1) solenoid valve. The solenoid valve body shall be of Brass construction with Buna seals. The ball valve shall be of brass construction with a stainless-steel ball. The system shall have an output of 15 GPM at 60 psi. The spray connection shall be ½ inch NPT.

I. DRIVE SYSTEM- The unit drive system shall consist of a gearmotor mounted on a sealed drive mounting bracket and a drive shaft that connects the gear reducer output to the shaft of the screw.

J. GEARMOTOR. The gearmotor shall be a single speed, dual voltage electric motor direct coupled to an SEW Eurodrive helical gear reducer.

1. The electric motor shall be a 3 horsepower for severe duty motor with a 1.15 service factor, rated for use in a 40° C ambient temperature. The TEFC motor shall be NEMA design A with Class F insulation, 1800 rpm output speed, and a 230/460 volt, 3-phase, 60 Hz power supply. The motor conduit box shall have one (1) 1/2-inch NPT and one (1) 3/4" NPT conduit connection.

2. The helical gear reducer shall be AGMA class II (1.6 service factor) with minimum 94% efficiency, producing an output speed of 14 rpm and an output torque of 13,900 inch-pounds. Heavy duty tapered roller bearings in the gear reducer shall provide a maximum thrust capacity of 6,740 pounds.

   Gear reducers with service factors of less than 1.4 and efficiencies of less than 94% shall not be allowed.

K. DRIVE MOUNTING BRACKET. A drive mounting bracket shall be provided to mount the gearmotor to the drive end support leg of the unit. The bracket shall be made of type 316 stainless steel.

A compression type packing gland seal shall be provided on the mounting bracket to seal the drive shaft. PTFE packing rings shall be fitted into the seal housing and held in place by a two-bolt stainless steel gland follower.

L. DRIVE SHAFT. The drive shaft will be direct coupled to the spiral and constructed of carbon steel. The shaft will be painted, except in the area of the shaft that extends into the hollow bore of the reducer.

M. INLET HOPPER AND COVER

1. A 12 gauge (0.105 inch) stainless steel inlet hopper shall be supplied to direct screenings and liquid into the drainage trough. The chute shall be flange bolted to the trough, with each side of the chute being a minimum 60 degrees from horizontal.

2. A 12 gauge (0.105 inch) stainless steel cover shall be supplied to cover the remaining top of the main body.

3. A rubber gasket shall be provided to seal the feed hopper and cover

N. DISCHARGE PIPING

1. 14 gauge (.075 inch) stainless steel discharge pipe shall be fitted to the discharge end support leg to direct screenings into a customer provided receptacle. All discharge pipe flanges shall be 304L stainless steel. Aluminum flanges shall not be allowed.

2. The end of the discharge pipe shall be equipped with a bagging device to contain and enclose the pressed screenings. The device shall be fitted with a replaceable magazine of continuous clear plastic hose, 22-inch diameter by 260 feet long, 1.5 mm thick.

O. PIPE SUPPORTS- Pipe supports shall be supplied by the manufacturer.

P. FASTENERS- All fasteners shall be type 18-8 stainless steel.

Q. FABRICATION

1. Weld size, type, and procedure shall provide the necessary strength and facilitate the manufacturing of the specific component.

R. SURFACE FINISH

1. All stainless-steel components shall have standard mill finish and shall be mechanically cleaned to remove weld discoloration and fabrication markings.
2. The screw and drive shaft shall be finished with an enamel coating.
3. The motor and gear reducer shall have the standard manufacturer's finish.

S. ELECTRICAL DEVICES AND CONTROLS Electrical device interconnecting conduit and wiring shall be the responsibility of the installing contractor. In addition to the drive motor, the following electrical devices shall be furnished with the unit:

1. SOLENOID VALVES. Two (2) 120-volt, single phase, 60 Hz solenoid valves for the wash zone and flush spray washes housed in NEMA 4X enclosures shall have 18-inch long integral leads and will have 1/2-inch NPT conduit connections.
2. EMERGENCY STOP. A NEMA 4X polycarbonate emergency stop push button will be mounted to the end flange and shall have a 1/2-inch NPT conduit connection.
3. CONTROL PANEL: A Control Panel shall be provided to control the RDS and AWP. The AWP controls shal be housed in the same panel as the Screen controls.

T. SEQUENCE OF OPERATION (Overview)

1. HAND OPERATION. When HAND mode is selected, the screw will run continuously. When either spray wash HAND mode is selected, the spray wash will run continuously.
2. INTERMITTENT AUTOMATIC OPERATION. The control panel will be equipped to control the wash cycle, screw movement and flush cycle. Each wash or flush cycle and the screw movement will be controlled independently through the use of timers and counters. The drive motor and spray washes will be controlled automatically when the selector switches are placed in the AUTO position.
    a. The press motor starts after an adjustable accumulated run time from the interlocked feeding equipment. The press motor will run for an adjustable length of time, typically set at 0.3 seconds.
    b. The press motor continues to run, and the washing solenoids open for an adjustable length of time, typically set at 3-5 seconds. The press motor stops for an adjustable length of time typically set at 5 seconds.

c. Motor stop/start cycle repeats for an adjustable number of counts, typically set at four (4) to seven (7).

d. The washing solenoids close and the press motor runs for an adjustable length of time, typically set at 13.5 seconds, to dewater and discharge the screenings.

e. The flush solenoid opens for an adjustable length of time after the press motor stops, typically set at 10 seconds. The system will reset after the flush solenoid closes.

3. EMERGENCY STOP. The unit can be deactivated at any time by pressing either the control panel mounted or unit mounted Emergency Stop Safety Tag-Line switch.

4. FAULT CONDITIONS. Motor overload or high motor current conditions will stop the motor and illuminate the fault light.

2.2 CONTRACTOR RESPONSIBILITIES

A. The Contractor shall be responsible for reviewing the design of the equipment provided by the manufacturer, so that it fits properly in the structure and interfaces properly with associated equipment provided by others.

B. The Contractor shall be responsible for receiving the equipment, unloading it from the common carrier, and storing it safely until it is ready to be installed.

C. The Contractor shall install the manufacturer's equipment in accordance with the manufacturer's Installation, Operation and Maintenance instructions.

D. The Contractor shall provide all field wiring between the electrical devices on the screen (motors, switches, valves, etc.) and the control panel. Contractor shall also provide all required local disconnects and junction boxes.

E. The Contractor shall provide all field piping, fittings, isolation valves, and components required to supply the necessary wash water to the spray system (as specified in Paragraph 1.7 A 6 a).

F. The contractor shall be responsible for supplying and installing sixteen (16) 1/2"-13UNC by 5-1/2 inches long type 304 stainless steel expansion anchor bolts.

PART 3 - EXECUTION

3.1 INSPECTION AND STORAGE

A. The equipment shall be shipped assembled and as much as possible (depending on size of unit, drives and supports may be shipped loose). The Contractor shall be responsible for inspecting the equipment upon receipt of goods at the jobsite, unloading, and storing the equipment in a reasonable manner and protecting the motors, gearboxes, and controls from the weather in accordance with the Installation Operation and Maintenance manual.

3.2 INSTALLATION

A. The Contractor shall install the equipment in the structure, according to the Contract Documents and the approved submittals provided by the manufacturer, following the instructions detailed in the Installation Operation and Maintenance manual.

B. Upon completion of installation by the Contractor and startup of the equipment by the manufacturer's field service representative, the equipment will be operated under the supervision of the Contractor for a minimum of eight (8) hours to ensure that all operating characteristics are within acceptable limits.

END OF SECTION

INDEX TO

SECTION 44 44 19 – LIQUID ALUM FEED SYSTEM

SECTION 44 44 19

LIQUID ALUM FEED SYSTEM

PART 1 – GENERAL

1.01 SCOPE

A. There shall be supplied as shown by the plans one (1) complete Liquid Alum Feed System by Burnett, Inc. This proposed system will include alum storage tank., alum feed pumps, tank and pump appurtenances and controls.

1.02 QUALITY ASSURANCE

A. All equipment furnished under this Section shall be of a design and manufacture that has been used in similar applications and it shall be demonstrated to the satisfaction of the Owner that the quality is equal to equipment made by that manufacturer specifically named herein.

B. To insure a consistent high standard of quality, the manufacturer is to comply with storage tank, feed pumps and appurtenances applicable standards mentioned herein.

C. Unit responsibility. Tank and pumps, and all other specified accessories and appurtenances shall be furnished by Burnett, Inc. manufacturer including system warranty.

1.03 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01 33 00.

B. The submittal data shall be prepared, in its entirety, by the equipment manufacturer. Shop drawings prepared by the manufacturer's sales representative, fabrication shop or other than the listed manufacturers shall not be acceptable. No additions or modifications to the manufacturer's submittal will be accepted, with the sole exception of a cover sheet provided by the manufacturer's local representative.

1.04 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Section 01 78 33.

B. Include installation instructions, assembly views, lubrication instructions, and replacement parts lists.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, handle, and protect under provisions of Section 01 65 00.

1.06 SERVICES OF MANUFACTURER

A. Furnish the services of a representative of Burnett, Inc. to assist in adjusting and testing

the equipment furnished, to supervise the initial operation, and to make final adjustments as may be necessary to assure the OWNER that the complete system is in satisfactory operating condition.

B. Furnish sufficient supervision, data, and information from the manufacturer to train operators in the proper operation and maintenance of the system furnished.

PART 2 – PRODUCTS

2.01 The Alum Storage Tank

A. Storage Tank shall be one piece molded high density linear polyethylene tank constructed to ASTM D1998 standard, built from all virgin resin with a nominal capacity of 6,500 gallons and a maximum diameter of 10 feet. Tank will have outside level indication on the tank.

1. Tank Appurtenances

a. (1) 24" top access with threaded cover

b. (1) molded calibrated gauge strip

c. (4) molded lift lugs

d. (2) 2" raised face welded flange nozzle (pump suction)

e. (1) 2" raised face welded flange nozzle (Drain)

f. (2) 2" welded HDPE vent

g. (1) 2" raised face welded flange nozzle (Alum Fill)

h. (1) 2" welded full coupling (level sensor)

i. (1) ladder

B. (LCP-1) Alum Control Panel (shared enclosure with proposed Lime Slurry System)

1. All motor starters, relays, timers, and devices for the control and operation of the equipment shall be housed in a control panel provided and shared for both Alum Feed and Lime Slurry Systems.

C. Tank Level Control

1. OMEGA LVU-816 Series ultrasonic level transmitter and controller.

2. Level will display on a Red Lion digital readout located on the door of the Lime Control Panel LCP-LS-1.

D. Feed Pumps

1. Two SoloTech Model 10 positive displacement, peristaltic hose pumps, using lubricated single roller technology and reinforced style hose. (The System Lime/Alum Control Panel and PLC will be designed and pre-wired now for a future third Alum pump to be purchased during Phase II expansion).

2. Feed Pumps shall be a hose pump package with direct coupled gear-motor drive system, TEFC electric motor for operation on 3-phase, 230/460V 60Hz service. Pumps will be controlled by Variable Frequency Drive allowing the pump speed / flow to be controlled though a 4-20 ma signal to the system PLC and to remote operation via Ethernet connection. Remote connection by others.

3. Pumps shall be mounted on a steel base plate and secured to the pump platform of the enclosure.

4. Variable Frequency Drive SMVector shall be mounted in the enclosure.

5. For Burnett Alum System with a System PLC, the pump selector switch placed in Auto, ready to receive an input signal from the remote plant integration system via Ethernet interface provided by the Owner/Contractor. The Burnett Lime and Alum PLC shall send the 4-20 mA corresponding input signal to the feed pump to adjust the speed of the motor via the VFD from 1 to 60 Hz and provide an output signal back to the Burnett Lime Model B Lime System PLC for monitoring.

E. Feed System Accessories

The alum feed system will include the following accessories based on the information provided: Calibration column, y strainer, Back pressure valve, Pressure relief valve, pulsation dampener, and pressure gauge with isolator.

F. The Alum Pump Enclosure

The proposed Alum Pump enclosure is shared with the proposed Lime feed system. Refer to Specification Section 44 44 59 "Lime Slurry System" Paragraph 1.02 – "Feed Pump Enclosure" for details.

G. Valves – All valves shall be true union PVC Ball Valves.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Contractor to install/ provide:

1. Foundations, floor slabs, trenching, grading, grating, and electrical conduit in slab.

2. Grounding for the pump enclosure and tank.

3. All drainage from floor drains.

4. Curbs and containment structures.

5. 480V, 3-Ph, 60 Hz., 60 Amp power to the power panel and terminating in the shared Lime and Alum power panel.

6. Remote signal available via General Contractor provided Ethernet.

7. Service water, pressure not to exceed 70 pounds to the Alum system.

8. All trenching, feed line conduit, open trenching, wall sleeves coring, and tapping and insulation.

9. Heat tracing, if required.

END OF SECTION

INDEX TO

SECTION 44 44 59 – CAUSTIC SODA SYSTEM

SECTION 44 44 59

CAUSTIC SODA SYSTEM

PART 1 – GENERAL

1.01 SCOPE

A. There shall be supplied as shown by the plans one (1) complete Caustic Soda System by Burnett, Inc. This proposed system will include alum storage tank., Caustic feed pumps, tank and pump appurtenances and controls. The Pump and Control System is pre–assembled, and factory tested at our manufacturing facility prior to shipping.

1.02 QUALITY ASSURANCE

A. All equipment furnished under this Section shall be of a design and manufacture that has been used in similar applications and it shall be demonstrated to the satisfaction of the Owner that the quality is equal to equipment made by that manufacturer specifically named herein.

B. To insure a consistent high standard of quality, the manufacturer is to comply with storage tank, feed pumps and appurtenances applicable standards mentioned herein.

C. Unit responsibility. Tank and pumps, and all other specified accessories and appurtenances shall be furnished by Burnett, Inc. manufacturer including system warranty.

1.03 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01 33 00.

B. The submittal data shall be prepared, in its entirety, by the equipment manufacturer. Shop drawings prepared by the manufacturer's sales representative, fabrication shop or other than the listed manufacturers shall not be acceptable. No additions or modifications to the manufacturer's submittal will be accepted, with the sole exception of a cover sheet provided by the manufacturer's local representative.

1.04 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Section 01 78 23.

B. Include installation instructions, assembly views, lubrication instructions, and replacement parts lists.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, handle, and protect under provisions of Section 01 65 00.

1.06 SERVICES OF MANUFACTURER

A. Furnish the services of a representative of Burnett, Inc. to assist in adjusting and testing the equipment furnished, to supervise the initial operation, and to make final adjustments as may be necessary to assure the OWNER that the complete system is in satisfactory operating condition.

B. Furnish sufficient supervision, data, and information from the manufacturer to train operators in the proper operation and maintenance of the system furnished.

C. The Tank will be shipped directly from the manufacturer, received by Burnett in coordination with the Pump and Control Enclosure, and set on the prepared site provided by the Owner.

D. The Pump and Control Enclosure will be transported to the site by our technicians and set into place in conjunction with the storage tank.

E. Burnett's installation and startup technicians will provide all final installation terminations and system extensions.

F. Burnett will provide both startup and technical training for the operators. Specific operational procedures, reporting, and safety training will be the responsibility other Owner.

PART 2 – PRODUCTS

2.01 CAUSTIC SODA TANK

A. Tank shall be single compartment, welded steel reinforced top, having a nominal capacity of 16,000 gallons and a maximum diameter of 12 feet.

B. Tank shall be fabricated using steel as specified by ASTM A36.

C. Tank design shall be in accordance with AWWA D100 with minimum top and bottom plate thickness of ¼–inch and minimum wall plate thickness of 3/16–inch.

D. Tank appurtenances shall be as follows (refer to tank drawings for preliminary orientation):

1. 12–inch mixer mounting nozzle (top)
2. 24–inch atmospheric manhole / inspection port (top)
3. 24–inch manhole (3–1/2 feet above bottom)
4. Two 6–inch nozzle (pump suction, 9–inches above bottom)
5. 3–inch nozzle (drain, 2–inches above bottom)
6. 2–inch nozzle (overflow, 6–inches below top)

7. 2–inch nozzle (vent, top)

8. 6–inch nozzle (level sensor – 18–inches off wall, top)

9. 2–inch nozzle (soda fill, top)

10. Four Anchor lugs

11. Four 10–inch wide by 10 feet long gusseted baffles fabricated from ¼–inch plate positioned 1–inch off the wall

12. Ladder and full tank perimeter handrail (carbon steel)

13. Standoff pipe supports and clamps (maximum 8 feet on center for overflow, and soda lines).

14. Two Lift lugs

15. Soda Fill pipe (2–inch), with quick–connect

16. Overflow Pipe (4–inch)

17. Four 1" anchors furnished and installed by Burnett.

E. Surface Preparation and Painting.

1. The exterior of tank dome, wall, and appurtenances shall be prepared by commercial sandblast followed by one coat of MoPoxYTM High Solids Epoxy Coating 41–series by Tank Manufacturer. Field painting, by General Contractor per specification.

2. Tank Manufacturer shall coat the bottom of the tank with coal tar epoxy: Mo–TarTM C–200 Epoxy Coating.

2.02 FEED PUMP ENCLOSURE

A. The pump enclosure shall be a nominal 10' x 13' metal building with the tank shell forming one wall. The minimum clear height of the enclosure shall be 7'6".

B. The enclosure building shall be stainless steel frame (2" stainless steel) with 3" vinyl backed insulation. The 26-gauge exterior wall panels, roof panels, and flashings shall be coated with a factory finish of MBSC Signature 200 Polar White SR.58, SRI 69 minimum 0.8 mil over a minimum 0.2 Dynaprime PMY0154 primer.

C. The enclosure accessories shall include:

1. One 36–inch by 84–inch access door with hardware.

2. One 1000–watt UL–listed corrosion resistant heater with thermostat/on–off switch. Heater shall be Chromalox Model HVT–2411.

3. One 115–volt corrosion resistant fan having minimum free air capacity of 524 CFM. The fan shall be thermostatically controlled. The fan shall be fitted with a wire guard and removable interior vent door. Provide

manually adjustable, FRP air intake vent with FRP screen. The exhaust fan shall be Dayton Model 1BLH6.

2.03 CONTROLS

2.03.1 (LCP– 1) CAUSTIC AND ALUM CONTROL PANEL

A. All motor starters, relays, timers, and devices for the control and operation of the Caustic and Alum equipment shall be housed in a control panel mounted in the Caustic side of the pump enclosure. A PLC within the Control Panel shall provide remote signal/equipment interface with the plant system via Owner/Contractor provided Ethernet cable.

B. The Burnett B Caustic Soda system with PLC is designed to be a stand–alone, self–contained Caustic delivery system or may be remotely operated from a plant SCADA System via Ethernet cable provided by the Owner/Contractor to the Burnett supplied Allen–Bradley MicroLogix 1400. A list of addresses will be provided to the HMI programmer for status display. Remote input to the Caustic System is necessary for the motor speed (0–100%). This motor speed is generally calculated by the plant's own supervisory PLC/HMI system, based on flow rates, pH, anticipated Caustic needs, etc. as a 0–100% value of motor speed.

C. The Owner/Contractor shall provide a 480V, 60 Amp, 3–phase power feed to the flange mounted circuit breaker located in the Caustic System control panel. A control power transformer with primary and secondary over current protection will be provided.

D. Enclosure: NEMA 4X 304 SS, bottom entry, flange–mounted disconnect. A grounding lug is provided within the panel to assure positive system ground.

E. Components:

1. Circuit Breaker: Isolation Breaker for the Panel shall be a 60 Amp Type M breaker /ITED 43B060L or equal.

2. Starters and Motor protection: Pump motors will be controlled and protected by Allen Bradley Model 100–C and 140M–C2, Type E self – protected manual starters with adjustable amperage breakers. Motor Protection shall conform to IEC Circuit Breaker requirements as defined by IEC 947–2 and UL/CSA listed.

3. Relays: Relays shall be general–purpose control type, 10 amps, 600–volt reversible contacts. Relays shall be equal to Allen–Bradley, Type 700H.

4. Selectors: 30.5 mm, NEMA 4X rated; contacts shall be rated 10 amps continuous, 6 amps breakers at 24 VDC, manufactured by Allen–Bradley, Type 800H.

5. Weatherproof Horn: Horn shall generate a loud audible alarm for high level or mixer failure when activated by 24 VDC power. The horn shall

surface mount with sealable side conduit entry and shall be rated for NEMA 4X. Horn shall be equal to Federal, Model 450E.

6. Indicator Lights: Provide 30.5 mm full voltage type LED indicator lights as equal to Allen–Bradley type 800H for each motor.

   a. Green: Run

   b. Amber: Fault and Low Level

   c. Red: High Level and Reorder

   d. White: Power On

F. Surge Protection: AC power wiring shall be protected against lightning spikes and other transient surges at control panel. Protection shall be as manufactured by Siemens TPS series.

2.03.2 (LIT–1) CAUSTIC TANK LEVEL CONTROL

A. Caustic level control shall be the Milltronics MultiRanger tank level transmitter and indicator. The level indicator will be utilized to produce an audible high-level alarm located on the exterior of the pump enclosure and high level, low level, and re–order indicator lights are located on the exterior of the system control panel. Level signal may be obtained by the plant supervisory system through the Caustic system PLC.

B. Panel Enclosure shall be a polycarbonate enclosure rated NEMA 4X located in the pump enclosure.

C. The level transducer/transmitter shall be a 6" flange mounted Model XPS15 transducer as manufactured by Milltronics.

2.04 TANK MIXER

A. The tank mixer shall be vertical, flange mounted with one axial flow and one radial flow impeller sized and positioned to maintain a homogenous mixture of up to 30% Caustic Soda at ambient temperature. Mixer shall be suitable for operation in a 12' diameter by 19' straight shell atmospheric tank.

B. The motor shall be designed specifically for direct mounting to gear reducer. Motor shall be a TEFC, Frame DRN132 Premium Energy Efficiency, with a severe duty canopy with the following characteristics:

Horsepower: 10 HP

Maximum Speed: 1750 rpm

460 volt, 3–phase, 60 Hz

Continuous Duty

TEFC

C. A local mixer disconnect switch is located within visible sight of the mixer motor and entrance manway to the tank. All tank–mounted conduits shall be Schedule 80 PVC using suitable conduit hubs.

D. The speed reducer shall be designated for mixing service and operation in an outdoor environment.

E. The speed reducer shall be constructed and supported so that the shaft deflection, caused by operation loads, does not affect alignment of the anti–friction bearings or cause misalignment of gearing during mixer operation.

F. All reducer bearings shall be severe duty, anti–friction type, oil or grease–lubricated. The speed reducer shall be splash lubricated, by means of gears or a slinger rotating on a horizontal shaft in an oil bath, to ensure positive displacement of the oil upward for lubrication of critical bearings. A single oil drain shall be provided at the low point of the speed reducer to allow oil drainage and leave a maximum residual of oil of no more than ¼–inch in the drive housing.

G. The shaft and impellers shall be carbon steel. The maximum operating speed of the unit shall be 0.5 times the natural frequency of the shaft and impeller assembly. The shaft diameter shall be determined by an analysis of torque and bending moment as well as critical speed. Minimum shaft diameter shall be 3 inches. The shaft supporting the turbine shall be removable from the speed reducer without disturbing the gears of the speed reducer using a rigid flange coupling on the impeller shaft.

H. The mixer shall be Model LSM 16–30 with motor and gear reducer.

2.05 SODA FEED PUMPS

A. Two SoloTech Model 10 positive displacement, peristaltic hose pumps, using lubricated single roller technology and reinforced style hose.

B. Feed Pumps shall be a hose pump package with direct coupled gear-motor drive system, TEFC electric motor for operation on 3–phase, 230/460V 60Hz service. Pumps will be controlled by Variable Frequency Drive allowing the pump speed / flow to be controlled though a 4–20 ma signal to the system PLC and to remote operation via Ethernet connection. Remote connection by others.

C. Pumps shall be mounted on a steel base plate and secured to the pump platform of the enclosure.

D. Variable Frequency Drive SMVector shall be mounted in the enclosure.

E. For Burnett Caustic Model B Caustic Soda Systems with a System PLC, the pump selector switch placed in Auto, ready to receive an input signal from the remote plant integration system via Ethernet interface provided by the Owner/Contractor. The Burnett Caustic Model B Caustic system PLC shall send the 4–20 mA corresponding input signal to the feed pump to adjust the speed of the motor via the VFD from 1 to 60 Hz and provide an output signal back to the Burnett Caustic Model B Caustic System PLC for monitoring.

2.06 CHEMICAL FEED LINES

The soda feed lines shall be accessible in a PVC conduit (conduit provided by the Owner). The feed tubing to the Feed Point shall be either 1/4", 3/8", 1/2" or 5/8" ID clear flexible reinforced PVC hose (as determined by manufacturer) and shall be equal to Kuri Tec Series #K3150 or Nylobrade®.

2.07 VALVES AND APPURTENANCES

A. Automatic valves shall be actuated 3–way ball valves by Assured Automation.

B. Maintenance valves shall be true union 2–way manual PVC ball valves installed on each side of each pump.

C. Isolation valves for liquid Caustic service shall be 2–inch flanged, pinch valves, ONYX Controls or equal. There is one limit switch on all pinch valves, interlocked in the pump run circuit to assure positive position of the valve for pump protection.

D. Water Meter shall be positive displacement.

Note: The model numbers indicated above are to establish quality and Burnett reserves the right to provide equivalent components in the submission of the approval process.

PART 3 – EXECUTION

3.01 INSTALLATION

All installation shall be in strict compliance with the manufacturer's written instructions. All anchor bolts and other items shall be epoxy drilled and located according to certified prints furnished by the manufacturer, as approved by the Engineer. All electrical connections shall be made in accordance with the National Electric Code (NEC).

3.02 MANUFACTURER'S SERVICE

A. Furnish the services of a factory representative for one, eight–hour day during the installation phase of the equipment. The factor representative will have full knowledge and experience in the installation of the type of equipment being installed.

B. Furnish the services of a factory representative, having complete knowledge of

proper operation start–up procedure and maintenance requirements, for one, eight–hour day, to inspect the final installation, supervise a test run of the equipment, and instruct the Owner's personnel in the proper operation of the system.

3.03 MANUFACTURER'S SYSTEM WARRANTY

The manufacturer shall warrant that all supported materials and components will function as specified and be free from defects in manufacturing, design, and fabrication for a period of one year after the system is placed in operation.

Equipment components and accessories manufactured by others but purchased through Burnett Caustic Company, Inc., such as electric motors, valves, and other controls, are guaranteed only to the extent of coverage offered by their original manufacturer.

Expressly excluded from the warranty are defects caused by misuse, abuse, or improper applications, employment, or operation of the unit. The warranty does not cover acts of God, such as, lightning, explosion, fire, and flood or terrorist acts.

This warranty does not extend to damage caused by day–to–day operation considered normal wear items, such as tubes, seats, diaphragm, etc. Equipment, such as tank, mixer, pumps, and associated electrical equipment, is covered under this warranty, and if the equipment requires repair or replacement as a result of ordinary wear and tear under normal conditions, Burnett will repair or replace such equipment as required without cost to the Owner.

Alterations or changes to the Burnett B–2 system and/or soda without approval from Burnett could void the warranty.

THE SODA: The delivered soda concentration will be 30% and the system will feed an established dilution of the delivered concentrate. Strict quality control from the manufacturer is important to the smooth operation of the Burnett B–2 system. Consequently, carbide Caustics and generic slurries may have coarse inert particles that could interrupt chemical feeding.

SODA SPECIFICATIONS: Calcium hydroxide shall be a stabilized 30% aqueous suspension with a Specific Gravity between 1.19 and 1.23 g/ml. The Supplier shall certify no quick Caustic is used in the soda manufacturing process and only finely ground air–classified hydrated Caustic for preparation of the soda product. The soda solids will have 99% or higher passing 100 mesh screen. Soda product must be ANSI/NSF standard 60 certified. Delivery tankers shall be solely used for shipping soda and equipped with a system to avoid spillage during the off–loading. Delivery driver shall be responsible for proper dilution and request inspection by the on–site operator. Generic Caustic slurries can have large particulates that would require costly removal from the system storage tank. The supplier will guarantee the function of the Burnett B–2 Caustic Soda System from storage tank sediment and line stoppage with CAL~FLO® Soda and the prior listed specifications.

The above warranty is in lieu of any other guarantee, either expressed or implied.

Burnett's total liability under any circumstance shall not exceed the original purchase price of the equipment component in question and does not extend to any consequential damages or attorney fees that may result in the need for the replacement of nonconformity components.

3.04 CLEANING

Burnett will clean reactors of all debris prior to testing and start–up and will clean and remove from site all excess construction material brought on–site by Burnett utilized in the installation and start–up of the B–2 system.

3.05 STARTUP

Burnett will conduct a site acceptance test upon the completion of the installation. Tests will be conducted using water as the testing media. The Owner shall be responsible for the providing and disposal of the Water, and the providing of the power from either the permanent or temporary source.

3.06 CONTRACTOR TO INSTALL/ PROVIDE:

A. Foundations, floor slabs, trenching, grading, grating, and electrical conduit in slab.

B. Grounding for the pump enclosure and tank.

C. All drainage from floor drains.

D. Curbs and containment structures.

E. 480V, 3–Ph., 60 Hz., 60 Amp power to the control panel and terminating in the power panel.

F. Ethernet from Plant supervisory system to Caustic/Alum PLC within the system control Panel.

G. All trenching, feed line conduit, open trenching, wall sleeves coring, and tapping.

H. All water for flushing.

I. All insulation required for feed lines, water lines, pipes, tanks or valves.

J. Heat tracing, if required.

K. 1" Service water pressure, not to exceed 70 pounds to the Burnett B–2 Caustic Soda System.

L. Painting of the exterior of the tank dome, sidewall, and appurtenances.

M. The Contractor will clean and remove from site all excess construction material utilized in the installation of the Burnett B–2 Caustic Soda System

END OF SECTION

INDEX TO

SECTION 44 44 73

ULTRAVIOLET DISINFECTION SYSTEM (NON-CONTACT)

SECTION 44 44 73

ULTRAVIOLET DISINFECTION SYSTEM (NON-CONTACT)

PART 1 – GENERAL INFORMATION

1.01 SCOPE OF SUPPLY

A. Manufacturer shall furnish a complete in-line pipe flanged, low pressure high intensity (LPHO) Ultraviolet (UV) Non-Contact disinfection system to provide required disinfection of plant effluent waters prior to ultimate plant discharge.

B. UV systems that require lamps with input power greater than 145 watts shall not be considered. Amalgam lamps shall not be considered, system with quartz sleeve surrounded lamps shall not be considered.

C. The equipment shall essentially be automatic in operation, with no automated cleaning apparatus. Separate cleaning apparatus', integrated wiper mechanisms, quartz sleeves, O-rings, or lifting cranes shall not be required as per of the non-contact UV disinfections system.

D. The system shall be complete with power enclosures, power distribution and system controls shown on the contract drawings and specified herein.

E. Related Work:

1. Section 03 30 00 Cast in place concrete
2. Section 26 05 00 Electrical
3. Section 05 50 00 Metal Fabrications
4. Section 25 50 00 SCADA System

1.02 SUBMITTALS

A. The Manufacturer shall furnish electronic submittals consisting of the following information:

1. Detailed scope of supply
2. Mechanical/ assembly drawings.
3. Power/Control wiring single line diagrams.
4. Manufacturer's catalog information consisting of descriptive literature, specifications and materials of construction for all components

B. After successful startup, Manufacturer shall provide certification that the ultraviolet disinfection system is commissioned and is ready for service.

C. Manufacturer shall furnish the OWNER with three (3) hard copy and electronic copies (CD) of maintenance data on all machinery and equipment furnished for the system. The manuals shall include the following:

1. Equipment operating and maintenance instructions
2. Parts lists
3. Assembly and disassembly instructions
4. Equipment specifications and guaranteed performance data
5. Recommendations for preventive maintenance

6. Step-by-step operating and start-up procedures
7. Lists of spare parts, tools, and supplies
8. Wiring diagrams of all control circuits
9. Software programming as updated after final acceptance
10. Troubleshooting instructions

1.03 QUALITY ASSURANCE

A. Manufacturer's Qualification Requirements:

1. The equipment manufacturer shall be regularly involved in the manufacture and supply of low-pressure high output UV Disinfection systems for a minimum period of ten (10) years, and with a history of at least fifty (50) successful Municipal Wastewater installations of non-contact UV systems.

2. The UV Manufacturer shall submit a Bioassay Validation Report for the proposed reactor conducted and certified by an independent third party. The bioassay protocol, testing, QAQC, data analysis, and report shall be in accordance with the NWRI Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse (May 2012). The bioassay shall have been conducted on an identical UV reactor to the proposed UV reactor, with identical UV lamps, reactor lamp symmetry, and configuration. The UV manufacturer shall demonstrate that the scale up factor from the UV reactor used for bioassay testing to the proposed reactor is less than the maximum allowable scaling ratio. The bioassay report testing shall clearly indicate the proposed reactor(s) ability to meet the specified dose with the number of total UV lamps.

3. The bioassay report shall include evaluations of the reactor performance over varying range of flow per AFP tube, the range of UVT % tested, and the MS-2 Reduction Equivalent Doses calculated per NWRI 2012. The bioassay validation testing must include comprehensively the range of flow, UVT %, and UV MS-2 RED specified for this project. Extrapolations of flow rates, UV Transmittance values, or UV doses outside the range actually tested shall not be permitted for design of the proposed UV system(s).

B. UV Design Criteria:

1. The UV equipment to be supplied and installed shall meet the performance requirement as stated below:

Peak Disinfection Flow Rate- Phase I (Current Phase)	6.0 / 4,167.0	(MGD)/(GPM)
Peak Disinfection Flow Rate- Phase II (Future Phase)	12.0 / 8,133.5	(MGD)/(GPM)
Average Daily Flow- Phase I (Current Phase)	4.0 / 2,777.8	(MGD)/(GPM)
Average Daily Flow - Phase II (Future Phase)	8.0/5,555.6	(MGD)/(GPM)

Peak Hydraulic Flow Rate per UV Train	8.0/5,555.6	(MGD)/(GPM)
Number of UV Trains- Phase I (Current Phase)	2	One Duty- One Standby
Number of UV Trains- Phase II (Future Phase)	1	1 Additional train. Three total two duty, one standby)
UV Transmittance	65.0	% UVT (Minimum)
Total Suspended Solids	< 5.0	mg/l (maximum daily)
BOD*	10.0	mg/l (maximum for single grab sample)
Target Indicator Organism	Fecal Coliform	
Effluent Permit Criteria	23.00	Fecal Coliform Bacteria (count/100mL, Geometric Mean)
Validated MS-2 UV Dose	35	Minimum MS2 UV dose of 35 mJ/cm^2. UV Dose calculated per Independent Third-Party Bioassay conducted in accordance with NWRI 2012- after applying certified- Lamp End Of Lamp Life (EOLL) of 87%, and Fouling Factor of 89%.
End of Lamp Life Factor	.87	Validated by Independent Third party in accordance with NWRI 2012.
Fouling factor (FF)	.89	Validated by Independent Third party
Plant Process	Membrane Bioreactor (MBR)	
Particle Size*	<10	Microns
Total Iron*	0.3	mg/l
Effluent Turbidity*	<2.0	NTU Average

*Note: Industry standard water quality parameters assumed for UV selection based on upstream biological process (MBR).

C. UV Design Dose:

1. Peak Disinfection Flow Rate- 6.0 MGD per UV Train.

   a. The UV disinfection system shall be designed to deliver a MS-2 Dose of 35.0 mJ/cm2 under peak disinfection flow and design conditions listed in Section 1.3-B.1, after adjusting for lamp End of Lamp Life (EOLL) and Sleeve Fouling factor (FF). The MS-2 Dose must be verified by the third- party validation bioassay per sections 1.3- A.2, and 1.3-A.3

2. Peak Hydraulic Flow Rate- 8.0 MGD per UV Train.

   a. The UV disinfection system shall be designed to deliver a MS-2 Dose of 30.0 mJ/cm^2 under peak hydraulic flow and design conditions listed in Section 1.3-B.1, after adjusting for lamp End of Lamp Life (EOLL) and Sleeve Fouling factor (FF). The MS-2 Dose must be verified by the third-party validation bioassay per sections 1.3-A.2, and 1.3-A.3

3. The UV dose shall be adjusted using an EOLL factor of 0.5 to compensate

for lamp output reduction over the time corresponding to the manufacturer's lamp warranty. A higher EOLL factor shall be allowed only if manufacturer can provide third party verified Microbial testing (testing for EOLL using MS-2) data that has been collected and analyzed in accordance with protocols described in NWRI Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse.

4. The UV dose shall be adjusted using a FF of .5 for contact systems (using quartz sleeves) and non-contact systems. A higher FF shall be considered if manufacturer can provide third party certified report that supports a fouling factor greater than .5, up to a maximum of .9; use of fouling factor greater than .9 shall not be allowed.

D. Head Loss Through UV Reactor(s)

1. Flange to Flange Head loss through each UV reactor shall be as follows:

   a. Head loss through UV reactor/ Train < 24.00" at peak hydraulic flow rate of 8.0 MGD per UV Train^
   b. Head loss through UV reactor/ Train < 14.00" at peak disinfection flow rate of 6.0 MGD per UV Train^
   c. Head loss through UV reactor Train < 7.00" at average daily flow rate of 4.0 MGD per UV Train^

   ^Note: Headloss through UV reactors measured as difference in water level between effluent level control weir and Water level in influent tank. Because influent tank will be full of water ay peak flows, water level in influent tank may be measured using a 2.00" stand-pipe installed on the influent tank for head loss verification.

E. Operating Conditions:

1. The UV reactor shall be installed indoors, or outdoors with an awning, with ambient temperatures ranging from 35.0 ° F to 110 ° F
2. The UV system shall be designed to operate at a maximum pressure of less than 20 psi. Pumped flow through the UV unit shall require a pressure relief valve for protection against over pressurization/surges and appurtenances for air/vacuum release. The valve(s) to be installed shall be sized by the Manufacturer, reviewed by the engineer and supplied and installed by the CONTRACTOR.
3. The location and placement of the valves shall be as per the engineer's direction.

1.04 EQUIPMENT

A. The Ultraviolet Disinfection (UV) system shall consist of the following components:

1. Reactor Model No: C8t.10082
   a. Designation of reactor Reactors 01, 02 & 03(Phase II)
   b. Number of reactors: 2

2. Each reactor shall consist of the following:
   a. Number of Banks per Reactor: 2
   b. Number of AFP Tubes/ Bank: 80

c. Number of Lamp Racks/ Bank: 9
d. Number of Lamps/ Lamp Rack: 12
e. Number of lamps/ banks: 108
f. Number of Lamps per reactor: 216
g. Total number of ballasts per reactor: 216
h. Air to Liquid Heat Exchangers 4 per UV Bank
i. Cooling Pumps 2 Per UV Reactor
j. Effluent Level Control Weir 2 (1 per UV train)

3. The UV system shall include the following controls/monitoring:
   a. Ultrasonic Level Sensor 2 (1 per UV reactor)
   b. UV Intensity Monitor: 4 (1 per UV bank)
   c. ADR: 8 (2 per UV bank)
   d. EDC: 1 per UV reactor
   e. UV Control Panel: 1 common
   f. UV Master PLC Panel: 1 common
   g. Power Disconnect Panels: 4 (2 per UV bank)

4. The UV system shall include the following instruments:

   a. Bypass Line UV Transmittance Analyzer 1

5. Spare parts consisting of the following:

   a. Spare Ballasts (total 5.0% of all ballasts) 22
   b. Spare Lamps (total 10.0% of all lamps) 44
   c. Lamp Plugs/ Lamp End Connectors (5.0% additional) 22
   d. Proprietary Printed circuit boards (EDC, PIO, LRC Board, MLM, ADR, HUB) 1 each
   e. Proprietary Printed circuit boards
   f. (MLM) (5.0% additional) 5
   g. UV Intensity Sensor- Enaqua part number: 560.6019021
   h. Operator's safety kit includes UV resistant Gloves, and Face Shields that block UV light wavelengths between 200 and 400 nm: 2
   i. AFP Tube Cleaning Kit- Teflon Brush and extension kit with adaptable poles: 2

1.05 WARRANTY

A. PERFORMANCE WARRANTY

1. Manufacturer shall guarantee the specified performance (system shall meet minimum UV doses specified in Section 1.3.C under the conditions specified in the design criteria section) for a period of five (5) calendar years following equipment startup and acceptance to allow evaluation of performance under the specified water quality conditions. The system must be maintained and operated per the manufacturer's recommendations and instructions.
2. If the UV disinfection system fails to meet the performance guarantee criteria or fail to demonstrate performance, the manufacturer shall

modify, change, or add equipment as necessary to meet performance requirements. The manufacturer shall be responsible for any additional costs due to changes (including piping, mechanical, structural or electrical changes) or additional equipment as necessary to meet performance requirements. This includes design, engineering, construction, as well as equipment.

B. EQUIPMENT WARRANTY:

1. GENERAL WARRANTY:

a. The equipment furnished under this section shall be free of defects in materials and workmanship, including damages that may be incurred during shipping, storage, and installation, for a period of 2 years which shall commence after successful completion of the Initial Performance Test (Substantial Completion of the UV system).

b. All wiring in the train exposed to UV light shall be warranted for 15 years by the SUPPLIER. If the wiring fails before 15 years have elapsed, the SUPPLIER shall be responsible for the replacement of the wires and the labor.

c. Enaqua shall guarantee that for components manufactured by Enaqua, replacement parts shall continue to be available to the City for a minimum of 20 years from date of successful completion of Initial Performance Test. Enaqua shall guarantee that, if Enaqua or Enaqua's product line is sold, Enaqua shall make provisions such that all guarantees, warrantees, and bonds will remain in effect and that replacement parts and operational support shall continue to be available to the City for the time period specified above.

d. No warrantees shall be pro-rated, and all warrantees shall include all costs associated with required site visits, inspections, equipment removal costs, and equipment installation costs.

e. All warrantees and support shall be provided directly by the SUPPLIER and not the local manufacturer's representative.

2. UV LAMP WARRANTY:

a. UV lamps shall be warranted for a minimum of 16,000 hours operating time under the conditions specified herein non-prorated. In the event of premature UV lamp failure, the UV system supplier shall offer the following:

b. Lamp failure before 16,000 hours – send a replacement lamp free of charge.

c. This guarantee shall be limited by the guaranteed number of start/stop cycles. The guaranteed lamp start/stop cycle shall be 24 stop/start cycles per 24-hour period over the life of the lamp. The

automation associated with the UV equipment shall be programmed to prevent more than 24 start/stop cycles per day. Additionally, the automation system must log the operational hours for each individual lamp.

d. The guaranteed lamp life shall not include periods when the plant is not in operation and/or when the UV system is shut down.

e. SUPPLIER shall ensure all returned UV lamps (old/new) are recycled upon receipt of the returned lamps at the manufacturing headquarters for the life of the UV Disinfection System (20 years after successful completion of the Initial Performance Test).

3. UV BALLAST WARRANTY:

a. SUPPLIER shall guarantee all ballasts against failure for a minimum period of 10 years, which shall commence after successful completion of the Initial Performance Test (Substantial Completion of the UV system).

b. SUPPLIER shall replace any ballast that fails before the end of the designated warranty period at no cost to the City, with freight and insurance paid by SUPPLIER. Installation of the failed ballast can be performed by City.

4. AFP TUBE WARRANTY:

a. AFP tubes shall be warranted for twenty years as long as the wastewater flow and quality remain in the range(s) specified in the Design Criteria, and the UV system is operated in accordance with the O&M manual.

5. UV SENSOR WARRANTY:

a. UV sensors shall be guaranteed against failure for a minimum of five (5) years.

1.06 ACCEPTABLE MANUFACTURERS

A. The equipment manufacturer shall be regularly involved in the manufacture and supply of low-pressure high output UV Disinfection systems for a minimum period of ten (10) years, and with a history of at least fifty (50) successful Municipal Wastewater installations of non-contact UV systems.

B. Basis of Design for non-contact UV disinfection system and components shall be equipment manufactured and supplied by Enaqua, 2410 Birch Street, Vista, CA. All alternate manufacturers must be pre-qualified a minimum of 30 days prior to bid and must meet all performance, warranty, control and experience criteria.

1. Alternate equipment for the Basis of Design may be accepted for consideration if Seller of alternate equipment (Seller) adequately demonstrates to Buyer, at Buyer's sole discretion, that:

    a. The proposed alternate equipment shall be equal to the Basis of Design equipment and shall meet the design and performance criteria described herein, have the same warranty, shall maintain compliance of wastewater treatment plant discharge permit(s), rules, and regulations, and not result in any adverse impacts on OWNER, including, but not limited to, additional capital or operational costs.
    b. Seller shall indemnify buyer from any and all patent infringement claims that may arise from the purchase of seller's equipment.
    c. Seller shall pay all costs to Buyer to re-design and re-schedule the Project and revise the Bid and Contract Documents as necessary for the incorporation of the proposed alternate equipment.
    d. Seller shall provide documentation showing compliance with all sections of this specification at time of bid.

PART 2 - PRODUCTS

2.01 DESIGN, CONSTRUCTION AND MATERIALS

A. General

1. All module welded metal components in contact with effluent shall be Type 316 stainless steel.
2. All non-wetted metal components shall be Type 304 stainless steel with the exception of the Lamp Rack Assembly, which shall be constructed of aluminum and be capable of sustaining intermittent pedestrian traffic on the lamp racks.
3. All wiring exposed to UV light within the UV reactor, or electrical ballast enclosure shall be Teflon™ coated.
4. All wires connecting the lamps to the ballasts shall be enclosed inside the frame of lamp rack and not exposed to the effluent.
5. The effluent water shall be conveyed through the UV reactor via AFP_{840}™ tubes – there shall be no contact with effluent and quartz sleeves at any time during normal operation.
6. All wetted components in the UV reactor shall be: AFP_{840}™, 316 SS, PVC, ABS or other non-reactive, non-corrosive material.
7. The UV system (ballasts, lamps, and controls) shall be capable of 24 on/off cycles per 24-hour day for the full specified warranty life of the lamps and ballasts.

B. Lamp Array Configuration:

1. The lamp array configuration shall be the uniform array with all lamps parallel to each other and to the flow.
2. The UV reactor shall be designed to avoid any immersion of UV lamps in the Effluent.

3. The UV lamps shall be arranged around the outside of the AFP840™ tubes in such a way that each AFP840™ tube shall have no less than 6 lamps irradiating it at all times.
4. Reflectors optimized to reflect UVC wavelength of 253.7 nm and improve UVC energy density within the UV reactor shall be arranged in between the UV lamps in the lamp racks such that each AFP840™ tube reactor has a minimum of six (6) UV lamps and four (4) reflectors surrounding it.

C. Inlet/Outlet Flow Distribution:

1. Each UV reactor shall have an inlet and outlet tank. Plant effluent piping shall connect to each of the tanks to convey effluent through the UV reactor.
2. Connection to inlet and outlet tanks of UV reactor: Diameter: 24.00" Diameter (ASME/ANSI B16.5, CL 150 Flange)
3. Each UV reactor shall have a flow distribution sheet, so as to distribute wastewater efficiently through the AFP_{840}™ tubes.
4. The effluent tanks of the UV reactors shall have a flat weir installed to ensure minimum submergence of the AFP tubes under all flow conditions. The Flat weir shall be made of 304 SS and fabricated as an integral part of the discharge tanks.
5. The tanks and inlet flow distribution sheet shall be made of 304SS material. All material which comes in contact with the wastewater shall be non-corrosive.

D. Effluent Level Control:

1. Each UV reactor shall have effluent level control mechanism installed in the effluent tank. The weir plate shall be a rectangular flat weir. The weir geometry shall be designed such that the weir will flood varying # of AFP tubes based on flow thus achieving the required minimum submergence of the calculated # of AFP tubes and providing the minimum specified UV dose at varying flow conditions listed in 1.3.B.1.
2. The effluent level control shall be a removable rectangular flat weir plate, and a weir frame to mount the weir in the effluent tank of each UV reactor. The rectangular flat weir plates and all mounting hardware shall be of 316 SS, to be prefabricated and installed by manufacturer prior to shipment of UV reactor from factory.

E. AFP_{840}™ Tube Ultraviolet reactor:

1. Within the ultraviolet reactor, AFP_{840}™ UV transmitting tubes are arranged in a horizontal and vertical array. These AFP_{840}™ tubes are in a parallel mode and are attached at one end to the inlet flow distributor sheet and to the outlet flow distributor sheet with appropriate leak proof fittings. The AFP_{840}™ tubes shall be adequately supported.
2. In between and around the AFP_{840}™ tubes, lamp rack assemblies shall be placed in such a fashion so as to provide uniform and adequate ultraviolet light intensity. The lamp racks slide in and out between and around a row of AFP_{840}™ tube array.
3. Within the AFP_{840}™ UV reactor, all UV sensitive materials shall be protected from the UV light.

4. The flow path through the AFP$_{840}$™ tubes shall achieve optimized plug flow regime. The flow of wastewater should be in sufficient turbulent mode; therefore, the Reynold's number in each UV reactor would be greater than 50,000 at peak flow. A turbulent flow shall be in such a way that it scours the inner walls of the AFP$_{840}$™ tube to help prevent scaling or fouling.
5. The UV reactor shall be covered from five sides with either coated aluminum or stainless panels. The sixth side (top) shall have access door(s). The lamp racks shall be accessible through these doors.
6. The air temperature inside the AFP$_{840}$™ UV reactor shall be maintained between 90-120 deg. F by means of an air-air heat exchanger to minimize the potential for increase in the temperature of the disinfected effluent. The control of the reactor temperature shall ensure optimum UV light emissions from the UV lamp.
7. A temperature sensor shall be installed within the UV reactor for protection against heat build-up under no or low flow conditions.

F. UV Reactor Cooling System:

1. Cooling within the UV reactor shall utilize a series of air to water heat exchangers. The primary cooling water shall consist of disinfected effluent obtained downstream of the UV reactor via a centrifugal pump.
2. The UV equipment manufacturer shall supply the submersible cooling pumps and associated controls.
3. Control between the cooling water pump shall be done via a flow-switch located on the downstream end of the reactor.
4. Submersible Cooling Pumps
5. Two cooling pumps shall be supplied per UV reactor, one duty and one backup.
   a. The submersible cooling pumps shall be ITT GOULDS submersible Pump Model 1DW51D4EA.
   b. The design point of the pump shall be 20 gpm at 35 feet TDH with a rated power of 0.75 hp. Power to the pump shall be 460 V, 3 PH.

G. UV Lamps: The UV lamps shall have the following characteristics:

1. A low pressure, high output (LPHO) non-amalgam mercury vapor lamp of the hot cathode type.
2. The filament shall be of the clamped design, significantly rugged to withstand shock and vibration.
3. Each lamp will produce at least 90% emissions at the germicidal frequency of 253.7 (254nm) nanometers.
4. The power consumption shall be a maximum of 138 input watts per lamp, total including ballasts losses shall not exceed 145 watts including ballast losses. The rated UV output at 253.7 nanometers (nm) shall be a nominal 57 UVC Watts at 100 hours of operation.
5. The lamp shall have a minimum UV intensity of >400 microwatts/cm^2 at 1 meter.
6. Each lamp shall have a rated life of 12,000 hours.
7. Each lamp shall be single ended. Each lamp shall have a nominal arc length of 1400 millimeter.
8. Each lamp has a minimum length of 1554 mm.
9. Each lamp shall produce no measurable amount of ozone.

10. Each lamp envelope is made of fused quartz and is capable of transmitting at 90% of UV light at 253.7 nm.
11. Electrical connections shall be at one end of the lamp and have six (6) pins, dielectrically tested for 2,500 volts. Lamps that have 2-4 pins (instant start) may be considered. However, to be considered as an alternate, instant start lamp systems shall supply replacement spare lamps equal to 20% of the total number of lamps in the system.
12. Each UV lamp shall have a smart lamp Module (an integral unique lamp identification chip) embedded in the lamp pin connector that enables the lamp position in the UV reactor to be altered independent of a lamp holder. The smart lamp module shall be capable of measuring and storing at a minimum the following data for each UV lamp in a reactor:

    a. Part and Serial number (unique identification) of each individual UV lamp
    b. Total accrued run time hours
    c. Lamp ON/OFF cycles

H. UV Lamp Racks

1. The UV lamp racks shall be placed between rows of the AFP$_{840}$™ tubes.
2. The lamp racks shall typically slide in and out within a track that shall be attached to the main frame of the UV reactor.
3. The use of cranes, hoists or other mechanical lifting devices shall not be required.
4. The lamp rack assemblies shall be made from aluminum.
5. Electrical mounting sockets shall be attached to one end of the lamp rack.
6. The other end of the rack shall have slotted holes to slide lamps in and out during installation and removal of lamps.
7. Reflectors optimized to reflect UVC wavelength of 253.7 nm and improve UVC energy density within the UV reactor shall be arranged in between the UV lamps in the lamp racks such that each AFP840™ tube reactor has a minimum of six (6) UV lamps and four (4) reflectors surrounding it.
8. Quick power disconnects allow quick disconnect of the lamp rack assembly to the main power at the UV reactor chassis.
9. Each lamp rack shall be equipped with its own on/off switch and fuse.
10. Each lamp rack shall be equipped with an LED indicator to identify the operating condition of each lamp on the lamp rack.
11. Lamp Racks shall be removable for service during UV operation without impacting Hydraulic flow and still maintaining plug flow regime in the reactor.
12. Each lamp shall be controlled by an individual ballast. Systems that have one ballast controlling multiple lamps shall not be considered.
13. There shall be no quartz sleeves, O rings, seals, glands or retainers required to be around the lamps when installed in the lamp racks.

I. Electronic Ballasts:

1. The ballast used to energize the UV lamps shall be high frequency electronic ballasts. The ballasts shall be housed in the lamp rack assembly as an integral part of the lamp rack.
2. The electronic ballasts shall be rated at 120-277 V +/- 10% without discernible change of characteristics.
3. The electronics ballast shall have the following features:

    a. Power factor greater than or equal to 0.95.
    b. Electrical conversion efficiency greater than or equal to 90%.
    c. Ballast shall have high frequency phase returns from the UV lamps.
    d. The ballast operating frequency shall be between 40 and 150 K Hz.
    e. The ballast shall have a thermal overload protector to protect against overheating when ballast skin temperature reaches 75 deg. C.

J. Automatic Level Control Devices. Not used

K. UV Intensity Monitor

1. The UV reactor shall have a minimum of one UV intensity sensor which responds to the germicidal portion of light generated. The sensor shall not degrade after prolonged exposure to the UV light or effluent.
2. The sensor shall measure only the germicidal portion of the light emitted by the UV lamps as measured at 254 nm. It shall have sensitivity at 254 nm of greater than 95%. Sensors whose sensitivity to other wavelengths amounts to more than 5% of the total sensitivity shall not be allowed.

L. Ultrasonic Level Sensor

1. The inlet each reactor shall include an ultrasonic level sensors and transmitter provided by Manufacturer of the non-contact UV disinfection equipment, which will monitor the water level in the inlet box and transmit a signal to the EDC for activation and de-activation of UV lamps based on the level in the channel.
2. The ultrasonic level sensor/transmitter shall conform to the following requirements:

    i. Range: 8" to 16'-0"
    ii. Accuracy: ± 2% of span in air
    iii. Resolution: 0.039"
    iv. Beam width: 3"
    v. Dead band: 8"
    vi. Display tube: Six-digit LCD, using units of inches, centimeters, or percent
    vii. Display mode: Liquid height
    viii. Memory: Non-volatile
    ix. Supply voltage: 12 – 28 VDC
    x. Loop resistance: 500 ohms at 24 VDC
    xi. Signal invert: 4-20 mA
    xii. Calibration: Push button
    xiii. Fail-safety: Selectable 4 mA
    xiv. Process temp: -7^{0}F to 140^{0}F
    xv. Electronics temp.: -40^{0}F to 160^{0}F

xvi. Pressure: 30 psi @ 25°C, derated at 1.667 psi per °C above 25°C
xvii. Enclosure rating: NEMA 4X (IP65)
xviii. Enclosure vent: Watertight membrane
xix. Enclosure: PC/ABS FR
xx. Trans. Material: PVDF
xxi. Process mount: 2" NPT
xxii. Mount gasket :Viton
xxiii. Conduit entrance : Dual, 1.2" NPT
xxiv. Classification : General purpose
xxv. CE compliance : EN 61326 EMC

3. The ultrasonic level sensor/transmitters shall be EchoSpan Ultrasonic Level Transmitter Model LU81 or approved equal.
4. The ultrasonic level sensor/transmitter(s) shall be mounted atop a section of PVC pipe securely mounted vertically to the inlet tank and extending to within twelve inches (12") of the bottom of the inlet tank. The vertical pipe shall serve as a stilling basin for the ultrasonic level sensor transmitter and prevent false or no readings caused by water turbulence in the inlet tube sheets by inflows.

M. Bypass UV Transmittance Sensor and Controller

1. One (1) bypass UVT% sensor and controller shall be supplied by Enaqua and installed by contractor at location designated by the engineer on project drawings.
2. UVT Sensor shall be REALTECH REALUV M3000, with an automated pumping and cleaning system; REAL PUMP CLEAN SYSTEM I- or approved equal.

N. Electrical:

1. The UV reactor shall be powered from its own incoming power supply (to be supplied by others).
2. All cabling, conduit runs and wiring from the plant power supply to the UV reactor shall be as shown on the construction drawings.
3. The CONTRACTOR shall be responsible for bringing main and control power to the UV reactor through a Branch Circuit protections device (disconnect) as shown on the drawings.
4. Electrical power required shall consist of the following:

a. Lamp power to reactor(s): 480 VAC, 3 phase, 4 wire plus ground
b. Control power to reactor(s): 120 VAC, 1 phase, 2 wire plus ground
c. Power to cooling pumps: 480 VAC, 3 phase, 3 wire plus ground
d. Heat Exchanger power to reactor(s): 120 VAC, 1 phase, 2 wire plus ground
e. Power to UV Control Panel: 120 VAC, 1 phase, 2 wire plus ground
f. Power to UV Master PLC Panel: 120 VAC, 1 phase, 2 wire plus ground
g. Power for UVT Analyzer: 120 VAC, 1 phase, 2 wire plus ground

O. UV Power Panel Enclosures:

1. The power panel enclosures) for the UV banks, and pump panels, shall

consist of a UL 508-A NEMA 4X type 316 SS rated electrical enclosure. The power panel shall house the following:

a. All contactors, disconnects, terminations and fuses required to power the appropriate bank.
b. Electrical safety lock-out.

2.02 CONTROLS AND INTEGRATION

A. UV CONTROL SYSTEM - Electronic Data Center (EDC)

1. Each UV reactor shall be equipped with a supervisory microcontroller called Electronic Data Center (EDC). The EDC shall collect all the data from individual UV lamps, UV and other sensors in the system and shall display it at the HMI and remotely to the plant operation console. The Local display panel (HMI) shall display at a minimum the following data:

   a. UV Reactor in Duty/Stand-By
      i. HAND, AUTO or REMOTE modes

   b. ON/OFF status of lamps.
   c. Water level (depth) in UV inlet tanks.
   d. Error Status of lamps and sensors.
   e. Individual Lamp Hours for each UV Reactor and Bank
   f. An advanced signal for lamp service or replacement.
   g. Flow through UV system (in MGD/GPM)
   h. UV intensity for the Active UV Banks
   i. UV Transmittance % measured by UVT sensor
   j. Delivered UV dose in mJ/cm^2
   k. The type and location of the alarm.
   l. The frequency of alarms shall be counted and stored.
   m. Alarms and historical operating data shall be stored in a removable storage device in comma delineated format.

2. Communication between each UV rector and EDC's shall be via CAT5 or CAT 6 Ethernet cable.

3. Integration of alarms between the EDC's and Travis Field WRF's SCADA system PLC shall be via Modbus TCP/IP. Communication between the UV Control Panel and the plant PLC shall be via CAT6 Ethernet cable. A unique IP address to be assigned to each EDC by plant SCADA integrator during installation and integration phase.

   a. All registers of the EDC shall be available to the plant's SCADA system PLC

B. UV CONTROL SYSTEM- Local Display Panel (HMI)

1. The HMI for Enaqua's EDC's shall be installed and mounted in UL 508-A NEMA 4X type 316 SS rated electrical enclosure to provide graphic interface for monitoring and control.

2. The HMI interface shall be 19" NEMA 4X Touchscreen Industrial Display (Hope Industries Model HIS-ML19 (Rev. G)) with VIA Technologies Windows 10 PC AMOS-3005-1Q12A2), and shall display all system operational data, system operational history and shall allow access via remote internet connection for troubleshooting and system upgrades.

   a. The UV Control System enclosure shall house the following components:

      i. 19-inch color touchscreen display
      ii. Windows 10 PC
      iii. Ethernet Switch, 8 port 10/100BaseT(X) (RJ45 connector. Weidmuller Model IE-SW-BL08-8TX
      iv. Electronic Data Center's (EDC) EDC GEN 2- Part # 62.010037
      v. PIO (Enaqua I/O Modules). Part # 062.01003600
      vi. 24 V DC Power Supply. IDEC Slim Line Model PS5R-SB24
      vii. 600 VAC UPS. Allen Bradley MODEL 1609-B600N

   b. There shall be a three-way HOA control for each UV reactor allowing OFF, HAND, or AUTO (automatic) operation of the reactor providing control for the following;
   HAND: Shall provide local lamp control.
   OFF: Shall power off the lamps in the reactor.
   AUTO: Shall provide automatic lamp control from remote signal.

C. ALARMING AND CONTROLS:

1. Minor alarms shall be provided by each EDC via MODBUS TCP to plant's SCADA system to indicate to plant operators that maintenance attention is required. Alarms shall include:

   a. Low UV Intensity shall be pre-set at the factory for 70% of the intensity after 100 hours. Alarm set point shall be field adjustable.
   b. # Lamp Out
   c. Lamp Life approaching EOLL

2. Major alarms shall be provided each EDC via MODBUS TCP to plant's SCADA to indicate an extreme alarm condition in which the disinfection performance may be jeopardized. Alarms shall include:

   a. Low UV Intensity Alarm. This alarm shall be pre-set at the factory for 50% of the intensity after 100 hours burn-in of the lamps. The alarm set point shall be field adjustable. A low intensity alarm shall not cause any bank to turn off.
   b. Low UVT Alarm. Field settable, set at 65.0 at factory
   c. Low dose alarm. A low dose alarm shall be generated when the delivered calculated UV dose is below UV dose specified
   d. High flow alarm: A high alarm shall be generated when the flow in MGD approaches the peak design flow rate of the UV system.
   e. Adjacent lamp failure alarm
   f. Lamp rack power failure
   g. Master alarm

D. REMOTE MONITORING AND CONTROL:

1. The Run command for each UV reactor hard-wired connections from the Main Plant's PLC to PIO (Discrete Input module) for each EDC. The UV reactors can be turned on or off as required by the Main Plant's PLC/SCADA system by opening or closing dry contacts.

   a. With the switches for each UV Bank in the AUTO position, the reactors shall be controlled externally from the Enaqua HMI panel.
   b. Local control (on UV Control Panel): The switches shall override the control from HMI panel.
   c. Remote Start: Each UV reactor shall have the capability of remote start via dry contact from Main Plant's PLC.

2. The UV reactor shall have the capability of providing basic remote monitoring/control via the plants main console (or other designated computer). The plant shall provide either an Internet IP address specific to the UV system, or allow access through its network and via secure website.
3. Connection/integration of each EDC to Main Plant's PLC or SCADA system shall be via MODBUS TCP

E. UV CONTROL PHILOSOPHY

1. An outline of the appropriate number of UV trains, and banks required to meet the specified minimum UV dose is as follows:

   a. **Flow Pacing of UV Trains:**
      i. In Phase I both UV Reactors (UV-1 and UV-2) shall be online at all times for varying flows. Plant operators shall place the selector switch for the UV reactors in AUTO position, and after a 5-minute delay open the inlet isolation valve to the UV reactors.
      ii. Depending on total flow to the UV system, the UV Control system shall be programmed to perform flow pacing of the two UV reactor Banks in each UV reactor as follows:
      iii. When plant influent flow consistently reaches 90% of the disinfection capacity of two UV Banks (UV-1 Bank 1 & UV-2 Bank 1) of 6.0 MGD (5.4 MGD/3,750.0.0 GPM); the UV Control system shall activate two additional UV Banks (UV-1 Bank 2 & UV-2 Bank 2)
         1. If after a duration of 30 minutes the effluent flow has not increased > 3,750.0 GPM, the UV control system shall inactivate UV Banks (UV-1 Bank 2 & UV-2 Bank)

      iv. Flow pacing on falling flows shall follow the same pacing regime in reverse order after both UV reactors are online and the plant effluent flow drops below 4,167.0GPM.

b. **Level Pacing (UV Dose Pacing) of UV Reactors:**

i. Within each UV train the effluent rectangular flat weir shall control the level of water in the UV reactors based on flow. The Weir geometry has been designed to ensure that the minimum # of AFP tube required to be flooded downstream of the UV reactor at varying rows to deliver the minimum MS-2 UV dose specified (35.0 mJ/cm^2) at the minimum UVT% (65.0%), are flooded.

ii. This function is called controlled Level Pacing, wherein only the # of AFP tubes necessary to provide UV dose of 35.0 mJ/cm^2 based on flow and the specified minimum UVT% are flooded by the geometry and weir crest of the effluent weir. The associated UV lamps in each lamp rack of each UV bank, based on level of water in the channels are active, and the rest of the UV lamps are OFF. Level pacing of the UV lamps in the lamp racks of each UV bank is controlled by the EDC.

2. Using flow and level pacing, the UV system is designed to deliver a minimum UV dose of 35.00 mJ/cm^2 MS-2 RED under all flow and water quality parameters listed in Section 1.3.B & C.

3. The UV control system design shall allow operation of the UV system in either manual (HAND) or automatic (AUTO) modes.

4. UV reactor alternation: The alternation of the two UV trains and four banks UV banks shall be performed manually by plant operators ensure equalized operating hours of both UV reactors.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Installation of the UV equipment shall be by the Contractor in accordance with the Installation Contract Documents, and SUPPLIER's engineering drawings and instructions. SUPPLIER shall supervise the installation of the UV equipment. The Contractor, in accordance with the Installation Contract Documents and the SUPPLIER's engineering drawings and instructions, shall install the equipment provided by the SUPPLIER under the UV Disinfection Equipment System Proposal.

3.02 FIELD EQUIPMENT CHECKS

A. Equipment Checks: Prior to the Field Testing (as detailed below, including Hydraulic and Alarm Testing, Initial Performance Test, and other testing), the SUPPLIER shall check that all equipment is installed properly, and functions as specified herein. The equipment checks shall include, but not be limited to:

1. Proper installation and alignment of UV support structure defined as the trains containing the UV banks and associated mounting brackets.

2. Water tightness of all submerged equipment.
3. Proper placement of UV lamp banks to assure specified water levels relative to the lamps.
4. Electrical wiring and connections.
5. Proper operation of instrumentation, alarms, and operating indicators associated with the UV equipment.
6. Proper placement and operation of lamp driver/ballast and other equipment in the control panels.
7. Adequate ventilation in the control panels.
8. Proper operation of lamp bank shutoff switches and ground fault circuit interrupters.

B. Upon completion of equipment checks, the SUPPLIER shall submit to the City written certification that all UV equipment and accessory equipment associated with the UV disinfection system have been properly installed, are in good condition, are functioning properly, and are in accordance with the Installation Contract Documents.

3.03 FACTORY ACCEPTANCE TESTING

A. The UV disinfection system specified herein shall be factory assembled, and factory tested to the largest extent possible, complete with all components specified.

3.04 FIELD TESTING

A. Following the SUPPLIER's calibration of instruments, the SUPPLIER shall perform Component, System, and Operational Tests on the UV Disinfection Equipment System. It is the responsibility of the SUPPLIER and Contractor to jointly coordinate and arrange the times for testing and startup activities; however, the Contractor must confirm that these times are acceptable to the City.

C. Calibration:

1. Approximately 60 days prior to the Initial Performance Test, the SUPPLIER shall calibrate all instrumentation associated with the performance testing.
2. If retesting is required, the SUPPLIER shall recalibrate instruments associated with the retest if they have not been calibrated within the previous 60 days and submit that information to the Engineer prior to retesting.

D. Data Collection:

1. Direct readings from the instruments shall be used in the calculations to determine conformance with the guaranteed performance requirements.
2. Readings shall be obtained from digital trends from the UV Disinfection Equipment System PLCs and by manually recording the values directly from the instrument.
3. Record (and round if necessary) to the level of accuracy of the instrument before any calculations.
4. Collect manual instrument readings at 4-hour intervals during the Initial Performance Test and at 1-hour intervals during the Average Power Consumption Test.

5. There shall be no adjustment to readings or calculations due to random or systematic instrumentation error or accuracy limitations.
6. The SUPPLIER shall document all modifications, changes, or additions and amend the operations and maintenance manuals and record drawings to reflect the modifications.
7. All modifications required as a result of Initial Performance Test failure must be completed within 90 days of the start of the original testing period.

E. Retesting: The SUPPLIER shall be responsible for all retesting. SUPPLIER shall recalibrate all instrumentation associated with the retest in accordance with this Section, if the instrumentation has not been calibrated within the 60 days immediately prior to the retest.

3.05 HYDRAULIC AND ALARM TESTING

A. After the City accepts the SUPPLIER's written certification of proper installation of the UV Disinfection System as specified herein, the HYDRAULIC AND ALARM TESTING shall be performed to determine whether or not the equipment meets the hydraulic and alarm conditions specified herein. HYDRAULIC AND ALARM TESTING protocol shall be submitted to the Engineer for approval a minimum of 30 days prior to the scheduled UV system startup:

1. Headloss Tests: Headloss through one train shall be measured and plotted on a curve showing flow rate in MGD on the horizontal axis and headloss in inches of water on the vertical axis. The level upstream of the first bank of lamps and the level downstream of the last bank of lamps shall be used to verify the estimated train headloss specified by the Supplier in Form 1 of this Section. A minimum of five headloss measurements shall be taken during this test at approximately 25, 50, 75, 100 and 120 percent of the design peak flow rate per train.
2. Alarm testing shall include simulation of flow and water quality change, lamp and bank failures, sensor performance alarms and the proper maintenance of the minimum UV dose over a range of flow and water quality conditions, in accordance with this specification.

3.06 INITIAL PERFORMANCE TEST

A. Following completion of the ALARM AND HYDRAULIC TESTING and calibration of all instruments, the SUPPLIER and the Contractor shall conduct the INITIAL PERFORMANCE TEST (IPT). The IPT shall be conducted to determine whether or not the equipment meets the Performance Test Requirements specified herein.

B. The SUPPLIER and the Contractor shall provide the IPT Report within 10 working days of completion of the test period.

C. To perform the test, the SUPPLIER and the Contractor shall operate the system continuously over a 5-day test period, and collect and summarize data to demonstrate that the system meets the following Performance Test Requirements:

1. Net Production Capacity: System meets average daily flow and peak flow rate requirements as defined in this specification.

2. Minimum Design Dose: System can deliver the minimum design UV dose as defined in this specification.
3. UV Disinfected Effluent Water Quality: UV Disinfection system produces an effluent in complete compliance with requirements as specified in this specification.
4. Cleaning: The on-line, automatic cleaning system cleans the lamps as thoroughly and frequently as is required for the system to deliver the minimum design dose at all times. The cleaning system maintains the Sleeve Fouling Factor.
5. Chemical Cleaning: one UV bank shall be chemically cleaned at the end of the IPT period. This cleaning shall restore the UV sleeves to its state of cleanliness at the onset of the IPT test. This shall be quantified by comparing the UV intensity measured at this bank at the onset of the IPT testing and after the chemical cleaning and adjusting for ambient UVT.
6. No major changes in equipment or apparatus will be permitted during this test period. However, minor adjustments of equipment that would normally be expected during regular operation of the equipment in plant use may be made.

F. SUPPLIER shall submit a detailed protocol to be followed for the IPT at least21 days in advance. The protocol shall include the proposed laboratory to analyze the IPT samples. The protocol and laboratory require written approval by the City before initiating the tests. The protocol shall specifically detail the operational mode of the system, sampling program, method and schedule, equipment and system monitoring data to be collected with each sampling, the daily (manual) log format, and all sampling and analytical procedures. Upon acceptance of the protocol by the City, the SUPPLIER shall commence the performance test. The SUPPLIER shall collect and process influent and effluent samples 2 times per day and test for turbidity, influent, and effluent Total Coliform, and transmittance for the test period.

G. Successful completion of the IPT shall be defined as continuous operation over the IPT test period without a major failure in the system and demonstration that system meets all performance requirements established herein. Downtime resulting from City's operation will not be counted against the criteria of "continuous days of operation." If an individual train has a production capacity below 75 percent of its design production capacity for more than 24 hours, the IPT will be considered a failure.

H. If during the IPT, the system fails or shuts down, the IPT shall then be rerun, as described above, and additional testing, labor, materials, equipment, etc., associated with correcting deficiencies in the UV system, including the repeated performance test, shall be borne by the SUPPLIER. Each repetition of the IPT shall be for a continuous period unless failure to meet performance requirements as defined in this specification has been documented and modifications have been accomplished.

I. During the IPT, the City shall have the option of collecting samples for independent analyses to confirm measurements and analyses conducted by the SUPPLIER and the Contractor. The Engineer and the City shall have the option of witnessing all testing performed by the SUPPLIER and the Contractor. The SUPPLIER shall notify the Engineer a minimum of 2 weeks in advance of testing.

J. If the UV Disinfection Equipment System fails to successfully complete the IPT, the SUPPLIER shall have the option of repeating the test two more times, with all costs borne by the SUPPLIER.

3.07 ELECTRICAL ACCEPTANCE TESTS

A. Electrical Acceptance Tests: Verification of warranted power consumption shall be documented by electrical acceptance testing performed by the SUPPLIER with the oversight of the Engineer. This acceptance testing is separate and independent from the operational acceptance test described above, but may be conducted concurrently:

1. Electrical acceptance test shall consist of consecutive 8-hour measurement of kW usage and power factor on the UV bank(s) by the SUPPLIER. Test Protocol: Banks or Modules of the UV system shall be operated with all lamps in operation at 100 percent power. During this acceptance test, the power consumption, power factor and harmonic values at maximum power shall be measured at the PCC and continuously recorded using a power meter/analyzer (provided by the SUPPLIER for the duration of electrical testing).
2. The meters each shall provide accuracy of ± 0.25%, shall operate at frequencies between 47 to 63 Hz, and shall be furnished with a statement from the meter SUPPLIER attesting to its accuracy. The meters shall be connected to the PCC at a location acceptable to the City. In the event that SUPPLIER disputes result of the electrical acceptance testing SUPPLIER shall bear the entire cost of retesting by a third party mutually acceptable to City and SUPPLIER.
3. If maximum power consumption exceeds 35.0 kW for each UV train (two UV banks) with all UV lamps ON at 100 % power, the SUPPLIER shall make any and all modifications necessary to cause the system to meet the requirements, all without any additional cost to the City and meet the requirements of the Power Consumption Guarantee.
4. If the power factor is less than that as specified herein, the SUPPLIER shall provide any modifications necessary to adjust the power factor to meet the required power factor.
5. The installed UV equipment shall comply with the maximum harmonic distortion levels in IEEE 519-2014 Tables 1, and 2 as measured at the PCC. If the harmonic values exceed those recommended in the IEEE 519-2014 Standards for a general system classification, the SUPPLIER shall provide all modifications necessary to cause the system to meet the requirements without any additional cost to the City. The short-circuit current (I_{SC}) at the PCC is 50,000 amps at 480 volts.

3.08 TRAINING OF CITY'S PERSONNEL AND SUPPORT SERVICES

A. General Requirements:

1. Provide operations and maintenance training for items of mechanical, electrical and instrumentation equipment. Utilize SUPPLIER's representatives to conduct training sessions.
2. Coordinate training sessions to prevent overlapping sessions.

3. Provide Draft Operation and Maintenance Manual for specific pieces of equipment or systems prior to training session for that piece of equipment or system.
4. Satisfactorily complete Alarm and Hydraulic Testing before beginning operator training.
5. Following City's acceptance of Certificate of Proper Installation, the SUPPLIER shall perform a comprehensive training of City's personnel at the site or a classroom designated by the Engineer.
6. The training provided by the SUPPLIER's representative shall consist of both classroom and field training.
7. The SUPPLIER shall give the City a minimum of 30 days' notice prior to initiation of training. The SUPPLIER shall provide the City a copy of the printed training material for review when notice is given.
8. The SUPPLIER shall designate and provide one or more persons to be responsible for coordinating and expediting training duties. The person or persons so designated shall be present at all training coordination meetings with the City.
9. The SUPPLIER's coordinator shall coordinate the training periods with City personnel and shall submit a training schedule for each component of the UV Disinfection Equipment System for which training is to be provided. Such training schedule shall be submitted not less than 30 calendar days prior to the time that the associated training is to be provided and shall be based on the current plan of operation.

B. Specific Requirements per UV System:

1. In addition to the time necessary to complete the requirements established elsewhere within these Specifications, the SUPPLIER's representative shall also provide onsite services at times designated by the City, for the minimum person-days listed below, travel time excluded.
2. Installation Supervision and Inspection: Minimum 7 person-days to handle various requests by the City, including during the unloading of UV disinfection equipment system (assume one trip) and for providing installation assistance for the UV Disinfection Equipment System (assume one trip).
3. Start-Up and Field-Testing: Minimum 10 person-days to handle various requests by the City, for assistance during startup activities (assume two trips).
4. Operator Training: Training shall consist of a minimum of total of 16 hours, for multiple classes, of hands-on lectures on the UV Disinfection Equipment System operation and the maintenance requirements, including lamp chemical cleaning and replacement and repair processes for lamps, ballasts, wipers, sleeves and ancillary equipment. Training shall take place before the Initial Performance Test. The field training shall cover all shifts.
5. Maintenance Service – Service Scheduling:

    a. By City request any time during warranty period as specified on the Warranty Form.

6. SUPPLIER shall return for 2 additional days 1 year after final acceptance to review UV Disinfection System performance, operations, and maintenance.

7. Factory representatives of the SUPPLIER who have complete knowledge of the proper operation and maintenance of the equipment, shall be provided to instruct representatives of City on the proper start-up, operation, and maintenance.

C. The SUPPLIER shall include in his final proposal a price for the time and expenses listed above.

D. The SUPPLIER's representative shall be a qualified individual who has previously provided onsite services for the installation, testing, and startup of the SUPPLIER's identical system at a minimum of five wastewater treatment plant of similar size.

E. Telephone: Include the following in lump sum price:

1. Provide telephone support by means of a toll-free phone number for a minimum period of 3 years following installation and startup.
2. Provide a list of three or more names of individuals qualified to support operation and provide cell phone numbers for these individuals. At least one of the listed individuals shall be available at all times including nights, weekends, and holidays in the event of an emergency.

F. Service Scheduling:

1. By City, on request any time during warranty period as specified.
2. Factory representatives of the SUPPLIER who have complete knowledge of the proper operation and maintenance of the equipment, shall be provided to instruct City on the proper start-up, operation, and maintenance.

3.09 ELECTRICAL CONNECTIONS AND CONTROLS

A. Wiring and conduits for electrical power, controls, and instrumentation shall be provided by the CONTRACTOR.

END OF SECTION

INDEX TO

SECTION 44 45 16 – FINE BUBBLE DIFFUSERS

SECTION 44 45 16

FINE BUBBLE DIFFUSERS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Division 1 specification Sections, apply to this Section.

B. Additional requirements related to work specified in this Section include, but are not limited to, the following:

Section	Description
45 50 00	Membrane Bioreactor

1.2 SCOPE OF WORK

A. This section includes the design, manufacture, installation and start-up of a flexible membrane, fine pore aeration system including in-basin aeration components as shown on the Drawings and as specified herein.

B. The aeration system manufacturer shall provide single source responsibility for the complete aeration system including in-basin piping, diffuser assemblies and support components.

1.3 DEFINITIONS

A. Tank: Vertical walled reactor within which aeration occurs.

B. Diffuser Unit: Fabricated unit including diffuser support frame and flexible membrane which releases air to the water.

C. Diffuser Assembly: Fabricated assembly including diffuser units and assembly mounting components.

D. Air Drop Pipe: Vertical piping section from out-of-basin header stub to in-basin aeration system.

E. Air Manifold Piping: Air distribution piping from drop pipe to air distribution headers.

F. Air Header Distribution Piping: Air distribution piping from air manifold and diffuser assemblies.

G. Air Header Piping: Out-of-basin air distribution piping from the blower building to the header stubs.

H. Blower Manifold Piping: Air distribution piping between the blower discharge and air header piping.

I. Aeration Grid: Associated piping and diffuser components connected to a single drop pipe.

J. Standard Cubic Feet per Minute (scfm): Air at 68°F, 14.7 psia and 36% relative humidity.

K. Maximum Pressure: Pressure in blower manifold piping at the specified airflow rate.

L. Oxygen Transfer Efficiency: Percent of oxygen in the air stream that is dissolved to the wastewater under specified conditions of temperature, barometric pressure, airflow rate, and dissolved oxygen concentration.

M. Standard Oxygen Transfer Efficiency: Percent of oxygen in the air stream that is dissolved to clean water under conditions of 68°F, 14.7 psia, and zero dissolved oxygen.

N. Air Distribution Uniformity: Variation in air distribution between diffuser assemblies.

1.4 SYSTEM DESCRIPTION

A. Design Requirements:

1. Design in-basin air piping and diffusers to diffuse air throughout the aeration tank(s) in accordance with the specifications.

2. Design each diffuser assembly to provide uniform air release over the specified airflow range.

3. Design the aeration system to provide the specified oxygen transfer at the specified conditions.

1.5 SUBMITTALS

A. General:

1. A detailed engineering submittal package shall be provided in sufficient detail and scope to confirm compliance with the requirements of this section. Submittals shall be completed for all required components. Partial submittals will not be accepted.

B. Shop Drawings:

1. Detailed layout drawings for in-basin aeration components. Layout drawings shall include:

a. Layout and configuration of aeration system.

b. Detail drawings of diffuser assemblies showing components, method of construction, and attachment mechanism to air header distribution piping.

c. Detail drawings of all piping connections including drop to manifold, manifold to header and inline connections for manifold and headers.

d. Detail drawings of pipe support components.

C. Product Data:

1. Detailed listing of materials and materials of construction.

2. Product literature.

3. A complete bill of materials.

D. System Design and Performance Data:

1. The recommended minimum, average, peak, and maximum air flow per diffuser.

2. Design AOR to SOR calculations according to EPA method for fine bubble diffuser design showing air flow rate in SCFM and SOTE at the design conditions listed in this specification for the following:

a. average AOR

b. Peak AOR

3. Design calculations according to the EPA method for fine bubble diffusers showing AOR for the proposed system at the design conditions listed in this specification for the following:

a. Minimum air flow rate per diffuser

b. Maximum air flow rate per diffuser

4. A curve showing the oxygen transfer efficiency of the proposed system for air flux rates between the minimum and maximum air flow rates per diffuser at design conditions.

5. Include complete air headloss calculations for the aeration equipment from the top of the dropleg to the farthest diffuser bubble release point.

6. Design calculations showing uniform air distribution (+10% maximum variation) between any two diffuser units.

7. Design calculations for piping and support components.

8. Product Experience:

a. The supplier shall have experience in the design, manufacture, supply and commissioning of fine pore, flexible membrane aeration equipment identical to the type specified for this project.

b. The equipment submitted shall be of proven design and shall be referenced by at least three installations of similar size, having been in successful operation for a period of not less than four (4) years prior to bid date.

9. Guarantee:

a. All equipment and workmanship furnished under this contract shall be guaranteed to be free of defects in materials and workmanship for a period of twelve (12) months from the date of system start-up or eighteen (18) months from the date of shipment, whichever occurs first. Any such defects, which occur within the stipulated guaranty period, shall be repaired, replaced or made good at no cost to the Owner.

E. Installation Instructions:

1. Installation requirements and guidelines for all proposed equipment shall be provided.

2. Information on the aeration system shall include but not be limited to:

a. Diffuser unit assembly.

b. Diffuser assembly attachment.

c. Piping components and assembly.

d. Piping support components.

e. Any other information required to properly install the system provided.

F. Operation and Maintenance Data:

1. Operations and maintenance data for all proposed equipment shall be provided.

2. A testing plan designed to ensure consistently good quality and uniformity of the aerator assemblies.

3. Information on the aeration system shall include but not be limited to:

a. Air flow balancing.

b. Diffuser assembly maintenance and membrane replacement.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. General

1. The following manufacturers are acceptable provided they meet the requirements of this specification.

a. Aerostrip

b. Sanitaire

c. Acceptable Equivalent.

2.2 MATERIALS

A. Welded Stainless Steel Components:

1. Sheets and plates of Type 304 stainless steel with 2D finish conforming to AISI 304 and ASTM A240.

2. Limit carbon content to 0.30% maximum.

B. Non-welded Stainless-Steel Components:

1. Sheets and plates of Type 304 stainless steel conforming to AISI 304 and ASTM A240.

C. Fasteners and Anchorage Components:

1. 304 series stainless steel.

D. PVC Pipe and Fittings (Schedule 40 and 80):

1. Base material shall be ASTM D-1784.

2. Pipe shall be manufactured in accordance with ASTM D-1785 and ASTM D-2665.

2.3 AERATION EQUIPMENT

A. System Performance:

1. The aeration-mixing system(s) shall be designed to meet the following conditions:

2.

System Name	Pre-Aeration diffuser grid
Average AOR	TBD based on MBR zone contribution to AOR. Total

	12,000 lbs 02/day required for both pre air and MBR zone contributions.
Peak AOR	TBD based on MBR zone contribution to AOR. Total 18,000 lbs 02/day required for both pre air and MBR zone contributions.
Peak Dissolved Oxygen Concentration	1 mg/L
Average Dissolved Oxygen Concentration	2 mg/L
Minimum SOTE	2% per foot submergence
Alpha	.65
Beta	.95
Wastewater Temperature	20
Elevation	25 feet
Number of Basins	As shown on the plans
Basin Length	As shown on the plans
Basin Width	As shown on the plans
Side Water Depth	As shown on the plans

B. Flexible Membrane, Fine Pore Diffusers:

a. The diffuser unit shall be fully capable of operating under continuous or intermittent conditions.

b. Membrane shall be elastic and allow openings to close when the air supply is interrupted.

1. Diffuser assemblies shall be completely factory assembled.

a. Field solvent welding or assembly of diffuser unit is not acceptable.

2. Diffuser assemblies shall be shipped to the jobsite assembled and properly crated and protected for shipment and handling.

C. Aeration System Piping:

1. Out-of-basin air piping including blower manifold, air header, and header stubs are required and are to be supplied by others.

a. Fine bubble diffuser system and system maintenance shall be compatible with out of basin unlined ductile iron, galvanized steel, or stainless steel.

b. Others shall provide an isolating/balancing valve for control and distribution of air to the aeration grid and to allow isolating of the grid for inspection and maintenance on the header stub.

c. Isolation/balancing valve shall be positioned for accessibility from the top of the tank.

2. Drop pipes from top of basin headers to floor level diffuser grid shall be provided by installing contractor.

3. All submerged manifolds and header components shall be Schedule 40 PVC minimum.

   a. Use of PVC piping shall only be employed when diffuser mounting system reinforces pipe wall at each mounting location.

4. Pipe supports shall be all stainless-steel construction.

   a. Supports shall accommodate longitudinal movement in the piping components due to the thermal expansion and contraction over a temperature range of 100°F.

   b. Supports shall restrain the axial and rotational movement of the pipe while providing for unrestrained longitudinal movement.

   c. Supports shall allow leveling of the air piping with 2-inch minimum vertical adjustment at each support.

   d. Each pipe support shall be connected to basin floor by at least 2 anchor bolts.

   e. The integrated pipe support assembly shall be designed to withstand the associated uplift force of the piping and diffuser assemblies with a minimum design factor of safety equal to ten (10).

PART 3 – EXECUTION

3.1 INSTALLATION

A. Contractor shall furnish, inspect, store, and install aeration system in accordance with manufacturer's written instructions and approved submittals.

B. Diffuser assemblies on a common grid shall be installed within an elevation tolerance of ±1/4 inches.

C. Contractor shall provide all valves, air header piping, wall sleeves with seals, wall pipes, and concrete pedestals as necessary to complete the system as shown on the plans.

D. Air piping including blower manifold, header, and in-basin piping must be clean prior to delivering air up the diffusers.

E. Contractor shall be responsible for cleanliness of piping and may be required to manually clean pipe, or air or water flush piping as required.

3.2 START-UP

A. After installation is completed, the Contractor shall perform the following field tests in the presence of the Engineer and the Owner.

1. Fill the reactor to the bottom of the diffuser assemblies.

2. Adjust the pipe supports and diffuser assemblies such that all diffuser units are installed within ±1/2 inches of the design diffuser elevation.

3. Fill the reactor to a level of 2 feet above the top of the diffusers.

4. Release air to the system and inspect the system for air leaks at all piping or diffuser connections.

5. Check all membrane for cuts or tears that may have occurred during the installation.

6. Adjust any piping or diffusers that show leaks or disproportionate amount of airflow.

7. Operate the blowers at the design air rate and observe air release and air distribution patterns.

8. All water, air, power and labor associated with testing and adjustment of diffuser assemblies are to be supplied by Contractor.

END OF SECTION

INDEX TO

SECTION 44 45 16.1 – EFFLUENT OXGENATION SYSTEM

SECTION 44 45 16.1

EFLLUENT OXYGENATION SYSTEM

PART 1 – GENERAL

1.01 RELATED SECTIONS

A. Section 26 05 00 – General Equipment Requirements
B. Section 40 27 05 – Piping
C. Section 40 29 19 – Plug Valves
D. Section 40 91 00 – Instrumentation and Controls

1.02 REFERENCE STANDARDS

A. The following is a list of standards which may be referenced in this section:

1. Occupational Safety and Health Administration (OSHA)
2. National Fire Protection Association (NFPA) 53
3. Compressed Gas Association (CGA) G-4.1
4. American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (BPVC) Section VIII, Div. 1
5. ASME B16.1/B16.5 Pipe Flanges and Flanged Fittings.

1.03 SYSTEM DESCRIPTION

A. The Effluent Oxygenation System is designed to elevate dissolved oxygen (D.O.) levels at the City's WRF to assist in meeting permit requirements.
B. The Effluent Oxygenation System includes the following components, which are each supplied by individual manufacturers.

System Component	Qty
Oxygen Injection System	1
Sidestream Pumps	2
Air Compressor System	2
Oxygen Generator System	1
200 Gal. Oxygen Storage Tank	3
Oxygen Compressor	1

C. The Contractor is responsible for providing each component of the Effluent Oxygenation System, as well as complete system integration, including all installation and interconnecting piping and wiring.

PART 2 – PRODUCTS - OXYGEN INJECTION SYSTEM

2.01 OXYGEN INJECTION SYSTEM OPERATION CONDITIONS

A. One Oxygen Injection System shall be provided to operate under the following operating conditions:

Process Parameter	Value
Plant Effluent Flow Method	Pumped
Location of Oxygen Addition	Post Effluent Pump Station
Site Elevation Above Sea Level (ft)	~100
Max Temperature of Effluent (°C)	25
Oxygen Transfer Efficiency (OTE)	90%
Total Daily Oxygen Addition Required (lbs O_2/day)	534 @ 20 ft in Cone

B. One complete Oxygen Injection System includes the following components: include:
   1. Oxygen Injection Speece Cone for the rapid dissolution of oxygen gas
   2. Oxygen Injection System Controls, consisting of 2 separate panels:
      a) PLC based Process Control Panel with Pump Starter.
      b) Oxygen Flow Control Panel.

2.02 OXYGEN INJECTION SPEECE CONE

A. Oxygen Injection Speece Cone Dimensions and Parameters:

   1. Model Number: ECO2-4-6-PC
   2. Cone Diameter: 4 feet.
   3. Cone Nominal Height: 12 feet.
   4. Total head loss shall not exceed 25 feet through the Oxygen Injection System at design conditions.
   5. Side Stream Flow Rate: 1,100 gpm.
   6. Side Stream Pump Duty Head: 35 feet, plus friction losses.

B. The Oxygen Injection Speece cone shall be constructed of Type 304 stainless steel and fabricated to ASME standards for 100 psig pressure rated vessels.

C. Features:

1. Self-cleaning bottom discharge design.
2. Sight glasses.
3. Manway.
4. 6-inch ANSI 150-pound flanged inlet and discharge ports.
5. 1-inch female NPT threaded oxygen port.
6. System discharge instrumentation ports.
7. Bead blast finish.
8. Free standing vessel with lower mounting flange for anchoring.

2.03 OXYGEN INJECTION SYSTEM CONTROLS

A. Provide One Process Control Panel: PLC driven automatic system control with sensing features. The system shall be designed for automatic flow control with full manual backup control of oxygen flow and side stream pump control. The oxygen feed rate shall be continuously adjusted to the actual process water flow rate. The control panel shall be rated for use on a 120-volt power supply and shall be housed in a NEMA Type 4X stainless steel, 316 enclosures. The control panel shall contain an Allen-Bradley Programmable Logic Control (PLC), operator interface screen and have the capability to monitor system parameters for alarm indication and data logging and trending.

1. Instrumentation included with the system and controlled/monitored by the Process Control Panel:
   a. Oxygen mass flow controller.
   b. One (1) solenoid valve.
   c. One (1) actuated ball valve.
   d. Side stream flow meter.
   e. Side stream pressure sensor.
   f. Side stream temperature sensor.

2. PLC and I/O:

   a. Allen-Bradley MicroLogix Processor.
   b. Ethernet switch.
   c. MicroLogix fixed racks, power supplies, expansion analog and digital I/O.
   d. Trend recording: The PLC shall record the following data as a minimum:

      1) Oxygen addition, current day's total.
      2) Oxygen addition, previous day's total.
      3) Plant effluent flow.
      4) Side stream flow.
      5) Side stream pressure.
      6) Side stream temperature.

3. Operator Interface:

   a. Panel Door-mounted HMI:

      1) Trending and logging.
      2) Ethernet communication capable (for remote connection).

4. Main Control Enclosure:

   a. Preassembled and wired, NEMA 4X 316 stainless steel construction.
   b. System Hand-Off-Auto switch.
   c. Interposing I/O relays as necessary.
   d. Disconnects and fusing for AC power distribution.
   e. DC power supply and fusing for DC power distribution.
   f. All necessary wireways, wiring, labels, and miscellaneous hardware for a complete control panel.

B. Provide one Oxygen Flow Control Panel: **NEMA 4X, 316 Stainless steel** panel complete with oxygen mass flow controller, rotameter, solenoid valve, check valves, isolation valves and stainless-steel tubing and fittings as required. Panel will be powered, monitored and controlled by the Process Control Panel.

C. Additional Components: The following additional components will be provided for mounting on the Speece Cone for redundant control and system isolation of the oxygen delivery piping:

1. Isolation valve
2. Check valve.
3. Actuated ball valve.

D. External Inputs to Process Control Panel: (provided by the G.C)

1. Plant effluent flow rate.
2. Side stream pump signal(s).
3. System enable/permission to run.
4. Effluent D.O sensor signal

E. Description of Operation:

1. The Oxygen Injection System shall operate by redirecting a side stream of plant effluent and pumping it through the Speece Cone. Gaseous oxygen is fed into the Speece Cone by the Oxygen Control Panel as controlled by the Process Control Panel. The Speece Cone shall provide a large oxygen/water interface as generated by an intense bubble swarm

to achieve rapid oxygen dissolution such that the gaseous oxygen is completely dissolved before being blended back into the main effluent flow. The Oxygen Injection System shall not have a pure oxygen headspace inside of the vessel. The system shall contain no internal nozzles, mixers or inner baffles that are prone to clogging, and all openings shall be a minimum of 3 inches to avoid scaling and clogging. The Oxygen Injection System shall not be pressurized above the operating pressure of 20 ft of head.

2. The Process Control Panel PLC shall monitor the plant effluent flow rate, side stream water flow rate, and water temperature and system pressure. Based on this data, the PLC shall calculate the amount of oxygen required to meet the oxygen demand of the plant effluent. The PLC shall be capable of adjusting the oxygen feed rate into the Speece Cone by means of the mass flow controller to match the calculated oxygen demand.
3. The Oxygen Injection System shall be capable of automatically adding variable amounts of oxygen as required by varying plant effluent flow rates.
4. The PLC shall also monitor the side stream pump operation, side stream water flow rate, oxygen flow rate, and water temperature and system pressure. These parameters shall be checked against design inputs to ensure optimal system performance and provide for system shutdown and/or alarm notification if the operation is out of tolerance.

2.04 OXYGEN INJECTION SYSTEM SUPPLIER

A. Supplier Qualifications

1. The Oxygen Injection System Supplier shall have a minimum of 5 years of experience in similar installations with a minimum of 10 permanently installed and operating systems adding a similar amount of oxygen to what are required per these specifications. Five of the 10 systems need to be in operation greater than 3 years.
2. The System Supplier shall submit performance data from a minimum of 10 permanently installed and operational systems that prove a minimum oxygen transfer efficiency of greater than 90% under actual operating conditions. Data from factory tests with clean water or data from temporary pilot tests is not acceptable.
3. To achieve the high oxygen transfer efficiency, the system shall provide a large oxygen/water interface generated by an intense bubble swarm to achieve oxygen dissolution such that the gaseous oxygen is completely dissolved into the wastewater before being blended back into the main flow.
4. System operating pressure shall not exceed 20 feet of head.

5. Systems with a pressurized pure oxygen headspace shall not be considered.
6. The Oxygen Injection System should run continuously with a minimum amount of maintenance to guarantee reliable D.O. control. Therefore, the system shall contain no internal nozzles, mixers or inner baffles that are prone to clogging, and all openings shall be a minimum of 3 inches to avoid scaling and clogging.
7. The System Supplier shall be ECO Oxygen Technologies, LLC of Indianapolis, IN.

B. Unit Responsibility and Scope of Supply:

1. The Contractor shall be responsible for coordinating with Oxygen Injection System manufacturer for Contractor's Scope of Supply.
2. One complete Oxygen Injection System includes the following components:
   a) Oxygen Injection Speece Cone.
   b) PLC based Process Control Panel with Pump Starter.
   c) Oxygen Flow Control Panel.
3. The Contractor shall be responsible to provide and install, but not limited to, the following:
   a. Interconnecting water piping including valves and accessories.
   b. Oxygen feed piping to the System, and accessories.
   c. Installation and assembly of all equipment and instrumentation components for a complete system including labor.
   d. Site preparation
   e. Utility requirements, including main electrical service and field wiring.

2.05 SUBMITTALS

A. Action Submittals:

1. Detailed mechanical and electrical drawings showing equipment dimensions, system fabrication, arrangement, assembly, including locations and type of connections and weights of major equipment and components.
2. Power and control wiring diagrams, including terminals and numbers.
3. Factory finish system.
4. External utility requirements such as air, water, power, drains, etc., for each component.
5. Functional description of internal and external instrumentation and controls to be supplied including list of parameters monitored, controlled, or alarmed.
6. Control panel elevation drawings showing panel face layout, construction, and placement of operator interface devices and other elements.

7. Power and control wiring diagrams, including terminals and numbers and bill of materials
8. Complete set of engineered drawings for system I/O and Process control.
9. Installation Manual.
10. Installation history and experience –The manufacturer shall provide a list of names and dates of installations for verification by the Engineer or City's Representative.

B. Informational Submittals:

1. Manufacturer's Certificate of Compliance.
2. Warranty Certificate
3. Operation and Maintenance Manuals (3 hard copies, 1 electronic copy).
4. Manufacturer's Certificate of Proper Installation.
5. Equipment Testing and Field Startup Report.

2.06 WARRANTY

A. The manufacturer shall guarantee that the Oxygen Injection System will perform in accordance with the specifications when operated within the specified design conditions.

B. The manufacturer shall guarantee all materials and equipment to be free from all defects due to faulty materials or workmanship for a period of one (1) year from the date of startup and shall be limited to the repair or replacement of the Oxygen Injection system.

2.07 PERFORMANCE GUARANTEE

A. Oxygen Injection System Supplier shall guarantee that the System shall provide a minimum oxygen transfer efficiency of 90% or greater.

B. One-time performance testing as conducted during startup shall be means of proving performance criteria is met.

PART 3 – PRODUCTS – SIDE STREAM PUMPS

3.01 SIDE STREAM PUMPS

A. Quantity (2) Dry-Pit Pumps Flygt shall be provided, to act in duty/standby configuration for pumping a sidestream from the effluent force main, through the Oxygen Injection System, and return to the effluent force main.

B. Pump:

a. Furnish and install Two (2) dry pit non-clog wastewater pump(s). Each pump shall be equipped with a 20 HP submersible electric motor, connected for operation on 460 volts, 3 phase, 60 hertz, 52A wire service, with T-stand kit, Mount socket, and 8" ANSI Inlet Elbow Assembly.

C. Performance Requirements:

a. Capacity: 1,100 gpm.
b. Total Dynamic Head: 40 ft of head.
c. Minimum Rated Pump Hydraulic Efficiency at Rated Capacity: 75 percent
d. Constant speed.

D. Pump Configuration:

1. Pump shall be capable of operating in a continuous non-submerged condition in vertical (NT) position in a dry pit installation, permanently connected to inlet and outlet pipes. Pump shall be of submersible construction and will continue to operate satisfactorily should the dry pit be subjected to flooding.

E. Pump Construction:

1. Major pump components shall be of grey cast iron, ASTM A-48, Class 35B, with smooth surfaces devoid of blow holes or other irregularities. The lifting handle shall be of stainless steel. All exposed nuts or bolts shall be of stainless-steel construction. All metal surfaces coming into contact with the pumpage, other than stainless steel or brass, shall be protected by a factory applied spray coating of acrylic dispersion zinc phosphate primer with a polyester resin paint finish on the exterior of the pump.
2. Sealing design shall incorporate metal-to-metal contact between machined surfaces. Critical mating surfaces where watertight sealing is required shall be machined and fitted with Nitrile rubber O-rings. Fittings will be the result of controlled compression of rubber O-rings in two planes and O-ring contact of four sides without the requirement of a specific torque limit.
3. Rectangular cross sectioned gaskets requiring specific torque limits to achieve compression shall not be considered as adequate or equal. No secondary sealing compounds, elliptical O-rings, grease or other devices shall be used.

F. Cooling System:

1. Each unit shall be provided with an integral motor cooling system. A stainless-steel motor cooling jacket shall encircle the stator housing, providing for dissipation of motor heat regardless of the type of pump installation. An impeller, integral to the cooling system and driven by the

pump shaft, shall provide the necessary circulation of the cooling liquid through the jacket. The cooling liquid shall pass about the stator housing in the closed loop system in turbulent flow providing for superior heat transfer. The cooling system shall have one fill port and one drain port integral to the cooling jacket. The cooling system shall provide for continuous pump operation in liquid or ambient temperatures of up to 104°F (40°C). Operational restrictions at temperatures below 104°F are not acceptable. Fans, blowers or auxiliary cooling systems that are mounted external to the pump motor are not acceptable.

G. Cable Entry Seal:

1. The cable entry seal design shall preclude specific torque requirements to insure a watertight and submersible seal. The cable entry shall consist of dual cylindrical elastomer grommets, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter. The grommets shall be compressed by the cable entry unit, thus providing a strain relief function. The assembly shall provide ease of changing the cable when necessary using the same entry seal. The cable entry junction chamber and motor shall be sealed from each other, which shall isolate the stator housing from foreign material gaining access through the pump top. Epoxies, silicones, or other secondary sealing systems shall not be considered equal.

H. Motor:

1. The pump motor shall be a NEMA B design, induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber.
2. The stator windings shall be insulated with moisture resistant Class H insulation rated for 180°C (356°F). The stator shall be insulated by the trickle impregnation method using Class H monomer-free polyester resin resulting in a winding fill factor of at least 95%.
3. The motor shall be inverter duty rated in accordance with NEMA MG1, Part 31.
4. The stator shall be heat-shrink fitted into the cast iron stator housing. The use of multiple step dip and bake-type stator insulation process is not acceptable. The use of pins, bolts, screws or other fastening devices used to locate or hold the stator and that penetrate the stator housing are not acceptable.
5. The motor shall be designed for continuous duty while handling pumped media of up to 104°F.
6. The motor shall be capable of no less than 30 evenly spaced starts per hour.
7. The rotor bars and short circuit rings shall be made of aluminum.
8. Three thermal switches shall be embedded in the stator end coils, one per phase winding, to monitor the stator temperature. These thermal switches

shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the motor control panel.

9. The junction chamber shall be sealed off from the stator housing and shall contain a terminal board for connection of power and pilot sensor cables using threaded compression type terminals. The use of wire nuts or crimp-type connectors is not acceptable. The motor and the pump shall be produced by the same manufacturer.
10. The motor service factor (combined effect of voltage, frequency and specific gravity) shall be 1.15. The motor shall have a voltage tolerance of +/- 10%.
11. The motor shall be designed for continuous operation in up to a 40°C ambient and shall have a NEMA Class B maximum operating temperature rise of 80°C. A motor performance chart shall be provided upon request exhibiting curves for motor torque, current, power factor, input/output kW and efficiency. The chart shall also include data on motor starting and no-load characteristics.
12. Motor horsepower shall be sufficient so that the pump is non-overloading throughout its entire performance curve, from shut-off to run-out. The motor and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet or greater.

I. Bearings:

1. The integral pump/motor shaft shall rotate on two bearings. The motor bearings shall be sealed and permanently grease lubricated with high temperature grease.
2. The upper motor bearing shall be a two-row angular contact ball bearing.
3. The lower bearing shall be a two-row angular contact ball bearing to handle the thrust and radial forces.
4. The minimum L10 bearing life shall be 50,000 hours at any usable portion of the pump curve.

J. Mechanical Seals:

1. Each pump shall be provided with a positively driven dual, tandem mechanical shaft seal system consisting of two seal sets, each having an independent spring.
2. The lower primary seal, located between the pump and seal chamber, shall contain one stationary and one positively driven rotating corrosion and abrasion resistant tungsten-carbide ring.
3. The upper secondary seal located between the seal chamber and the seal inspection chamber shall be a leakage-free seal.
4. The upper seal shall contain one stationary and one positively driven rotating corrosion and abrasion resistant tungsten-carbide seal ring. The rotating seal ring shall have small back-swept grooves laser inscribed

upon its face to act as a pump as it rotates, returning any fluid that should enter the dry motor chamber back into the lubricant chamber.

5. All seal rings shall be individual solid sintered rings.
6. Each seal interface shall be held in place by its own spring system.
7. The seals shall not depend upon direction of rotation for sealing.
8. Mounting of the lower seal on the impeller hub is not acceptable.
9. Shaft seals without positively driven rotating members or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower seal faces are not acceptable.
10. The seal springs shall be isolated from the pumped media to prevent materials from packing around them, limiting their performance.
11. Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and shall provide capacity for lubricant expansion. The seal lubricant chamber shall have one drain and one inspection plug that are accessible from the exterior of the motor unit. The seal system shall not rely upon the pumped media for lubrication.
12. The area about the exterior of the lower mechanical seal in the cast iron housing shall have cast in an integral concentric spiral groove. This groove shall protect the seals by causing abrasive particulate entering the seal cavity to be forced out away from the seal due to centrifugal action.
13. A separate seal leakage chamber shall be provided so that any leakage that may occur past the upper, secondary mechanical seal will be captured prior to entry into the motor stator housing. Such seal leakage shall not contaminate the motor lower bearing. The leakage chamber shall be equipped with a float type switch that will signal if the chamber should reach 50% capacity.

K. Pump Shaft

1. The pump and motor shaft shall be a single piece unit. The pump shaft is an extension of the motor shaft. Shafts using mechanical couplings shall not be acceptable. The shaft shall be stainless steel – ASTM A479 S43100-T. Shaft sleeves will not be acceptable.

L. Impeller

1. The impeller shall be of Hard-Iron™ (ASTM A-532 (Alloy III A) 25% chrome cast iron), dynamically balanced, semi-open, multi-vane, back swept, screw-shaped, non-clog design. The impeller leading edges shall be mechanically self-cleaned automatically upon each rotation as they pass across a spiral groove located on the volute suction. The screw-shaped leading edges of the gray iron impeller shall be hardened to Rc 60 and shall be capable of handling solids, fibrous materials, heavy sludge and other matter normally found in wastewater. The screw shape of the

impeller inlet shall provide an inducing effect for the handling of up to 5% sludge and rag-laden wastewater. The impeller to volute clearance shall be readily adjustable by the means of a single trim screw. The impeller shall be locked to the shaft, held by an impeller bolt and shall be coated with alkyd resin primer.

M. Volute/Suction Cover

1. The pump volute shall be a single piece gray cast iron, ASTM A-48, Class 35B, non-concentric design with smooth passages of sufficient size to pass any solids that may enter the impeller. Minimum inlet and discharge size shall be as specified. The volute shall have a replaceable suction cover insert ring in which are cast spiral-shaped, sharp-edged groove(s). The spiral groove(s) shall provide trash release pathways and sharp edge(s) across which each impeller vane leading edge shall cross during rotation so to remain unobstructed. The insert ring shall be cast of Hard-Iron™ (ASTM A-532 (Alloy III A) 25% chrome cast iron) and provide effective sealing between the multi-vane semi-open impeller and the volute housing.

N. Protection

1. Each pump motor stator shall incorporate three thermal switches, one per stator phase winding and be connected in series, to monitor the temperature of the motor. Should the thermal switches open, the motor shall stop and activate an alarm. A float switch shall be installed in the seal leakage chamber and will activate if leakage into the chamber reaches 50% chamber capacity, signaling the need to schedule an inspection.
2. The thermal switches and float switch shall be connected to a Mini CAS control and status monitoring unit. The Mini CAS unit shall be designed to be mounted in the pump control panel.

O. Manufacturer and Product: Flygt; N-Series.

PART 4 – PRODUCTS – AIR COMPRESSOR SYSTEM

4.01 AIR COMPRESSOR SYSTEM GENERAL

A. Quantity (2) Rotary Screw Air Compressors Systems shall be provided, to act in duty/standby configuration.

B. Each Compressor must meet the inlet air requirements for the Oxygen Generation System as listed below:

1. Feed Air Requirements: 68 SCFM (average flow) at 100 PSIG incoming pressure
2. Air Quality Requirements (per ISO 8573.1 CLASS 1.4.1 MINIMUM):
3. Zero Dirt Particles larger than 1-5 Micron
4. Oil Concentration (including vapor) at or below 0.01 (</= 3ppm)
5. Water Pressure Dewpoint at or below +38 deg F (940ppm at 100 PSIG)

C. Air compressor shall be a single stage, fluid-injected, air-cooled rotary screw compressor completely pre-piped and with pre-wired control system panel. Compressor shall be Kaeser Compressors, Inc., model SK20T or pre-approved equivalent.

D. Compressor shall be manufactured under strict ISO 9001:2008 quality control standards.

E. Compressor shall be tested as a completely assembled, piped, and wired unit.

F. Capacity shall be 88 ACFM (per CAGI) free air delivery at a discharge pressure of 125 psig. Compressor shall be capable of continuous full flow operation 24 hr./day at rated capacity and pressure.

G. Motor voltage shall be 460V, 3 phase, 60 Hz. With **20 HP** motor. Control system voltage shall be 115 V, 1 phase, 60 Hz.

H. Standard compressor package shall be suitable for use in a 40°F to 115°F ambient temperature range.

I. Dual Compressor System shall be provided with integral refrigerated dryer with oil/moisture separator and automatic condensate drain.

J. Drive Motor shall have TEFC enclosure.

K. Control Cabinet

1. Control cabinet shall be designed to meet outdoor standards.
2. Electrical components shall be UL and/or CSA approved and labeled as required.
3. Electrical schematic diagram shall be included in the service manual for ease of reference.
4. Cabinet backplate shall be galvanized for improved grounding.
5. Starter(s) shall be integrally mounted and wired in the package and located in the control enclosure.
6. Starter(s) shall either be magnetic, wye-delta, reduced voltage starter(s), to ensure low starting current and reduce thrust-bearing loads; or, with variable frequency drive.

M. Compressor Instrument Panel

1. Instrument panel shall consist of a Sigma Control 2™ system, or an approved equal. Control system shall be designed for ambient temperatures ranging from –4°F to +140°F.

2. The controller shall have embedded controller technology and sophisticated operating system. The unit shall include a stabilized 24V DC power supply and remote start/stop programmable timers. A buffer battery with a lifetime of ten years shall be included for protection of system memory and internal clock. The unit shall be EMI (electromagnetic interference) protected to ensure proper functioning of the controller in industrial conditions. The unit shall include additional digital and analog inputs and outputs for monitoring of standard and optional sensors.
3. Standard communications include: RFID for user access and security, Ethernet for remote monitoring with included Web Server, and an SD card reader slot to enable long term data logging and saving of system parameters.
4. A user interface shall be integral to the unit and shall include ergonomic controls with LED indication of important functions, and a background illuminated, plain text and graphical display capable of displaying information in many languages.
5. The controller shall monitor critical compressor and control functions and shut the compressor down in the event of motor overload, high airend temperature, incorrect rotation, or loss of drive.

N. Compressor Control

1. Sigma Control 2™: Compressor shall have the option of Quadro, Vario, Dual, Continuous, and Dynamic control as standard. Switchable modulation control is an acceptable option. Compressor shall start and automatically load if system demands it. Compressor shall have adjustable time delay to shut down the compressor after running unloaded for a pre-determined period of time to avoid excessive motor starting.
2. Compressor shall cut in and out at a specific psig.

O. Compressor Enclosure

1. Compressor shall have steel frame assembly and be completely enclosed, including bottom. All models shall include hinged doors and/or removable access panels for easy access to the compressor for maintenance. All models shall incorporate a safety interlock switch on front access panel for protection of operators and maintenance personnel.
2. Enclosure shall be suitable for installation outdoors.
3. Enclosure shall be heavily sound insulated, and compressor shall have a maximum full load sound level of 68 dB(A) at 3 feet in accordance with ISO 2151 and ISO 9614-2. All sound dampening material shall be oil repelling and cleanable.
4. Additional vibration proofing shall be provided for the airend, drive motor, and separator tank to reduce stress on piping and electrical connections.
5. Compressor frame shall be isolated from the floor by rubber vibration pads. No special foundation shall be required.
6. All access panels/doors shall have slotted key locks or handles. A door key shall be provided.
7. Ambient cooling air shall enter enclosure after passing through a 40-micron filter mat.

8. Compressor shall be fitted with an air inlet filter rated at 1 micron.
9. Cabinet panels shall have a "powder coat" type paint finish, which shall be durable and scratch-resistant.
10. All access panels/doors shall be gasketed to minimize dust or dirt entering the compressor enclosure.
11. All major air and oil pipes shall be made of steel and feature flexible connections with o-ring seals to reduce the likelihood of cracks and leaks.

P. Testing & Inspection

1. Parts must be inspected as part of a strict ISO 9001:2008 quality control program.
2. Each compressor shall be run and tested for leaks, pressure, temperature, rotation, and full load amp draw.

Q. Maintenance and Spare Parts

One (1) year of standard maintenance parts shall be provided.

R. Standard Limited Warranty

Compressor package shall be warranted free of defects in material and workmanship for a minimum period of 18 months from date of shipment or 12 months from date of start-up, whichever occurs first. Compressor assembly, drive motor, magnetic motor starter(s), Sigma Control 2 shall be warranted to be free of defects in material and workmanship for a minimum period of 30 months from date of shipment or 24 months from date of start-up, whichever occurs first. There shall be no restrictions based on the purchase of special lubricants or maintenance kits.

PART 5 – PRODUCTS - OXYGEN GENERATION SYSTEM

5.01 OXYGEN GENERATION SYSTEM

A. One Oxygen Generation System shall be provided to supply high purity oxygen gas to the Oxygen Injection System where it will be dissolved into the plant's effluent, according to the following specifications:

1. The Oxygen Generator shall produce a minimum of 375 Standard Cubic Feet per Hour (SCFH) of Oxygen Gas from a source of clean, dry, compressed feed air
2. The Oxygen Generator System requires feed air to meet the following specifications (see section 4.01.B)
   a. Meets specification for the feed air quality us the ISO Specification 8573.1, Class 4. It states: Maximum Dust Particle size is 15µm; Maximum Oil content, including vapor, is 5 ppm; and Maximum dewpoint at 100 psig is 37°F or 940 ppm.
   b. Feed air volume is 68 SCFM on average, at capacity of at least 200 gallons

3. The Oxygen Gas produced by the Oxygen Generator shall have a concentration of 93.0% (+/- 3.0%).
4. The compressed feed air must be available from an Air Storage Tank (AST) with a storage capacity of at least 200 gallons. Tanks must be suitable for outdoor installation.
5. The Oxygen Gas produced by the Oxygen Generator shall be available from an Oxygen Storage Tank (OST) with a storage capacity of at least 200 gallons at a minimum pressure of 45 psig (3 Bar). Tanks must be suitable for outdoor installation.
6. The Oxygen Gas produced by the Oxygen Generator shall have a Maximum dewpoint of -76°F (-60°C) and typically be in the range of -100°F (-73°C).
7. The Oxygen Generator shall be painted green, which normally identifies equipment or transmission lines and hoses as containing Oxygen.
8. The Oxygen Generator shall be made in the USA.

5.02 DESIGN REQUIREMENTS

A. The Air Separation Technology used shall be Pressure Swing Adsorption (PSA) utilizing a two-bed system with both Pressure Equalization and Gas Purging to enhance system efficiency.

B. The Sieve Beds of the Oxygen Generator shall be designed, built, tested, inspected and stamped ('U' Stamp only, not 'UM'-stamped) in accordance with the American Society of Mechanical Engineers' (ASME) Boiler code, Section 8, Division 1.

C. The electrical and pneumatic controls for the Oxygen Generator shall be located inside an electrical enclosure box. An electrical enclosure box rated as **NEMA 4X, 316 S.S.** (IEC rated IP 66) shall be available which will provide a degree of protection against corrosion, windblown dust and rain and splashing or hose directed water.

D. The operation of the Oxygen Generator shall be controlled by a Programmable Logic Controller (PLC) which meets Conformite European (CE) guidelines for Noise Immunity and Radio Frequency Interference (RFI).

E. The PLC shall have at least one data communication port.

F. The wiring connections inside the enclosure box shall be made to valves, switches and power distribution terminals through DIN- rated electrical connectors. The entire system shall be rated 'Touch-Safe' and Compliant with CE Machinery Safety Regulations.

G. The DIN electrical connectors to the process control valves shall have internal lights to indicate when each valve is energized.

H. The wiring color shall conform to the International Standards Organization (ISO) Standard for Wiring Color Code (Brown-Hot, Blue-Neutral, Green/Yellow-Earth).

I. The electrical power consumption of the Oxygen Generator shall be less than 0.5 KW. The power supply for the oxygen generator shall be from a single-phase source of 115 or 230 VAC at 60 Hz.

J. The power supply for the air compressor shall be from a three-phase source of 460 VAC at 60 Hz.

K. The Oxygen Generator shall have both lifting lugs, to move it via connection to an overhead crane and forklift slots, for carriage by forklift.

5.03 INSTRUMENTATION AND CONTROLS:

A. The Oxygen Generator shall have a single, internally-lighted, three position Control Switch unless supplied with a touch screen. The three positions of the switch shall allow the operator to select the mode of operation (Off, Continuous Cycling or Automatic Operation).
B. The Oxygen Generator shall have a non-adjustable Digital Hours meter that records running hours.
C. The Oxygen Generator shall have an internal pressure switch which will turn the Generator on and off based on the Oxygen Storage Tank pressure. This switch will only be affective while the 'Automatic' mode of operation is selected on the Control Switch. The pressure switch set points shall be factory set but be adjustable for modification.
D. The Oxygen Generator shall have a dial gauge to indicate the Regulated Feed Air Pressure as feed air enters the Oxygen Generator.
E. The Oxygen Generator shall have a dial gauge to indicate the Oxygen Discharge Pressure as it departs the Oxygen Generator.
F. The PLC controlling the Oxygen Generator shall have indicating lights which indicate the point in the separation process the Generator is at while it cycles.

5.04 TESTING, CERTIFICATION, AND WARRANTY:

A. The unit shall be tested at the *OGSI* facility for a minimum of 4 hours at the rated output, monitoring Oxygen Flow Rate, Oxygen Delivery pressure and Oxygen Concentration.
B. A Certificate of Conformance to the Test Parameters shall be available to the Buyer Upon Request.
C. A Certificate of Origin indicating the unit to be 'Made in the USA' shall be available to the Buyer Upon Request.
D. The manufacturer shall provide the Buyer up to one-half day of training on the operation and maintenance of the Oxygen Generator, at no extra charge, at the Manufacturer's facility.
E. The manufacturer shall provide a Warranty on the unit, that it is free of defects in parts or workmanship (in accordance with manufacturer's Standard Warranty policy), for a period of 12 months from date of shipment. This period will be extended to 18 months from shipment in cases where startup does not occur within the first six months from the date of shipment, but in no case shall be any longer.

PART 6 – PRODUCTS - OXYGEN GAS COMPRESSOR

6.01 OXYGEN GAS COMPRESSOR

A. One (1) Oil-Less Oxygen Gas Compressor shall be supplied to increase the pressure of the high purity oxygen up to 150 PSIG.

B. The Oxygen Compressor shall receive oxygen gas from the Oxygen Storage Tank (OST), and provide the higher-pressure oxygen gas to the Oxygen Injection System Speece Cone.

C. The Oxygen Gas Compressor shall meet the following specifications:
   1. Size: 28" L x 25" W x 30"H
   2. Weight: 400 lbs.
   3. Inlet pressure: 3-50 PSIG
   4. Discharge pressure: Up to 150 PSIG
   5. Air Cooled
   6. Materials of construction appropriate for use with high purity oxygen gas
   7. Motor: **5 HP**
   8. Direct Drive
   9. Power Input: 460V/3ph/60Hz
   10. Controls: High Pressure Safety Shut Down
   11. Operation: Continuous
   12. Filtration: Y-strainer, 100 mesh

D. The Oxygen Gas Compressor shall be model 2TX1B

E. The Oxygen Gas Compressor shall be manufactured by RIX Industries, Benicia, CA

F. The Oxygen Gas Compressor shall be warranted for a period of 12 months from the date of startup, to meet the specifications herein and to be free from defects in quality and manufacture.

PART 7 – EXECUTION

7.01 GENERAL INSTALLATION

A. Manufacturers shall provide written instructions for installation of equipment by Contractor.

B. Anchor Bolts:

   a. Contractor will provide, and field install after receipt of equipment.
   b. Anchor bolts are as determined by local codes and regulations and Engineer's specification.

C. Equipment Materials:

   a. All components of the System shall be compatible with the conditions and chemicals to which they will be subjected to during normal operation.
   b. Compounds with which the materials of construction must be compatible include, but are not limited to:
      i. Hydrogen sulfide.
      ii. Sulfuric acid.

D. General Instrumentation and Controls

1. Provide control panels, electrical components and wiring for a complete, functional system.
2. Provide all items not specifically specified which are required to implement the specified functions and the functions required for proper system operation.
3. Coordinate controls with existing SCADA system.
4. Alarms shall be capable of being transmitted to the owner in accordance with their requirements, specified herein under Section XXXXX.

7.02 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. All materials and equipment shall be shipped, stored, handled and installed in such a manner as to not degrade quality, serviceability or appearance.

B. All exposed equipment openings shall be properly protected.

C. Appropriate measures shall be taken to prevent the entrance of moisture or water to equipment during shipment and storage onsite.

1. Control panels should be stored in an enclosed place, safe from the weather until installed.

7.03 MANUFACTURER'S SERVICES

A. Startup service shall be provided by factory-trained technicians at no charge to ensure equipment is running properly and adjusted to factory specifications. Maintenance instructions shall be discussed with customer to ensure they understand routine maintenance procedures. The maintenance training shall be conducted at the time of equipment startup.

7.04 FIELD TESTING

A. Prior to acceptance by Owner, an operational test of the Oxygen Injection System shall be conducted to determine if the installed equipment meets the purpose and intent of the Specifications. Tests shall demonstrate that all equipment is electrically, mechanically, and otherwise acceptable; it is safe and in optimum working condition; and conforms to the specified operating characteristics.

B. All equipment shall be tested to check for proper operation, proper alignment, faulty equipment, and for excessive vibration.

C. Any and all alterations, modifications, additions and/or work necessary to rectify defects or nonconformance with the Section of the Specifications shall be in such

a manner as to provide for the satisfactory operation of the system, all at no additional cost to the Owner.

D. All labor, instruments, equipment, apparatus, fuel, temporary piping and valving, water and electrical power required for testing shall be provided by the Contractor at no additional cost to the Owner.

END OF SECTION